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A METHODOLOGY FOR THE EVALUATION OF MANAGEMENT INFORMATION SYSTEMS AT PUBLIC TECHNICAL AND VOCATIONAL EDUCATION AND TRAINING COLLEGES IN SOUTH AFRICA

by

MARGARETHA MARIA VISSER

(Student number: 34747788)

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SUPERVISOR: Prof. J.A. van Biljon

JOINT SUPERVISOR: Prof. M.E. Herselman

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DEDICATION

To GOD all the glory.

Philippians 4:13

"I have strength for all things in Christ Who empowers me [I am ready for anything and equal to anything through Him Who infuses inner strength into me; I am self-sufficient in Christ's sufficiency.]"[1]

To my parents: John and Ruth Briers, whom I love dearly.

To my husband, Tony, daughters: Rozanne and Daniela, and my son in law Werner who have supported and encouraged me every step of the way.

[1] The quote was taken from the Amplified Bible (AMP), Classic Edition. (1987). The Lockman Foundation.

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DECLARATION

I declare that, **A METHODOLOGY FOR THE EVALUATION OF MANAGEMENT INFORMATION SYSTEMS AT PUBLIC TECHNICAL AND VOCATIONAL EDUCATION AND TRAINING COLLEGES IN SOUTH AFRICA**, is my own work and that all the sources that I have used or quoted have been indicated and acknowledged by means of complete references.

I further declare that I have not previously submitted this work, or part of it, for examination at UNISA for another qualification or at any other higher education institution.

SIGNATURE	DATE
(Mrs M.M. Visser)	

ABSTRACT

The support and promotion of public Technical and Vocational Education and Training (TVET) Colleges is fundamental in addressing South Africa's intermediate-level and artisanal skills as shortages in these areas contribute to considerable unemployment in South Africa. These institutions have been earmarked by the South African government for extensive growth. Therefore, efficient and effective management and accurate decision-making within these institutions are essential. The evaluation of the management information systems (MISs) within these institutions, which provide data and information to inform institutional short-term and long-term management decision-making and day-to-day operations, should take place on a regular basis to so enhance the reliability and accuracy of the data and information.

The problem is that no evidence of a *methodology* (artefact) for the evaluation of MISs at public TVET Colleges in South Africa could be found in the literature. Therefore, the rationale for this study is to develop a methodology for the evaluation of MISs at public TVET Colleges in South Africa. Hence the main research question for the study was formulated as: *What are the components that constitute a methodology for the evaluation of a MIS at a public TVET College in South Africa?*

The study was conducted according to a design science paradigm. Design science is underpinned by a pragmatic philosophical paradigm which considers thought as a tool for prediction, problem solving and action. The Design Science Research Process (DSRP) model informed the research process utilised to develop the artefact for this problem centred initiated study. The iterated activities of the DSRP model which include: design, demonstrate, evaluate and communicate, contributed to the refinement of the *methodology* (artefact). The artefact mainly underwent experimental evaluation to demonstrate its *applicability*. The *methodology* (artefact) was empirically evaluated at three cluster-random selected public TVET Colleges after all colleges, with similar MIS maturity levels, were clustered into groups.

The study contributed to the extant knowledge base of: theory building, on different levels. The main theoretical contribution is the final evaluated *methodology* (DSR artefact) which enables IT practitioners and MIS managers at public TVET Colleges in South Africa to evaluate their MISs on a regular basis. The *methodology* (artefact) presents a theory for design and action which satisfies the conditions of importance, parsimony and novelty on a micro-level. The study furthermore contributed to the extant literature on the theory of MIS success evaluation by contributing to theory on the measurement of MIS success constructs and measuring of the relationships between the constructs. Another theoretical contribution is the innovative evidence-based method by which the public TVET Colleges were clustered. The clustering method was used to ensure a more rigorous sample selection technique than purposive or convenient sample selection of cases and is generalisable to other knowledge domain contexts.

The research study furthermore produced results of interest to both technology-focused and management-focused audiences. For technology-focused audiences the processes by which the artefact was constructed and evaluated are described, thus establishing repeatability of the study and building the knowledge base for further research extensions by future design science researchers. The rigour of the artefact design process was complemented by a thorough presentation of the experimental design of the artefact's field test in three public TVET College environments which provides sufficient detail for management audiences to determine if sufficient organisational resources exist for utilisation of the artefact.

Keywords:
Artefact; Case study selection; Design Science artefact; Design Science Research; Evaluation methodology; Management Information System; Methodology; MIS success evaluation; TVET College; South Africa.

LIST OF PUBLICATIONS RELATED TO THIS STUDY

Visser, M.M. (2012). Towards developing an evaluation tool for business management information systems' success at public Further Education and Training (FET) Colleges in South Africa. Master of Science. School of Computing. University of South Africa (UNISA).

Visser, M.M., van Biljon, J.A. & Herselman, M.E. (2012). Modeling Management Information Systems Success: a study in the domain of Further Education and Training, in Conference of the South African Institute of Computer Scientists and Information Technologists: Contemplate Connect Collaborate. SAICSIT '12 October 01-03 2012, Pretoria, South Africa: ACM. Won best paper award.

Visser, M.M., van Biljon, J.A. & Herselman, M.E. (2013). Evaluation of management information systems: A study at a Further Education and Training College. *South African Journal of Information Management*, 15(1), p. Art. #531, 8 pages. doi: 10.4102/ sajim.15i1.531.

Visser, M.M., van Biljon, J.A. & Herselman, M.E. (2017). Evidence-based case selection: an innovative knowledge management method to cluster public technical and vocational education and training colleges in South Africa. *South African Journal of Information Management.* 19(1) [Online]. Available at http://www.sajim.co.za/index.php /SAJIM/article/ view/751.

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LIST OF ACRONYMS

Acronym	Description
ABET	Adult Basic Education and Training
ACM	Association for Computing Machinery
ADP	Automatic Data Processing
BAUD	Public Finance Management System
CEO	Chief Executive Officer
CINOP	Independent, international research and consultancy agency
CIT	Computing and Information Technology
COLTECH	Management information system for TVET Colleges
CRA	Constructive Research Approaches
CUS	Computer User Satisfaction
D&M	DeLone and McLean
DBE	Department of Basic Education
DHET	Department of Higher Education and Training
DoE	Department of Education
DR	Design Research
DSR	Design Science Research
DSRM	Design Science Research Methodology
DSRP	Design Science Research Process
EDP	Electronic data processing
ERP	Enterprise resource planning
ETQA	Education and Training Quality Assurance
EUCS	End-User Computing Satisfaction
FET	Further Education and Training
FETMIS	Further Education and Training Management Information System
FTE	Full-Time Equivalent
GDSS	Group Decision Support System
HCI	Human Computer Interaction
HEI	Higher Education Institution
HSRC	Human Sciences Research Council
ICIS	Integrated Compliance Information System
ICT	Information and Communication Technology
IS	Information Systems
IT	Information Technology
ITS	Integrated Tertiary System
LSEN	Learners with Special Educational Needs
MIS	Management Information System
NATED	National Accredited Technical Education Diploma

NC(V)	National Certificate Vocational
NEET	Youth not in Education, Employment or Training
NQF	National Qualifications Framework
NSA	National Skills Authority
NSDS	National Skills Development Strategy
Pastel	Accounting software
PCA	Principal Component Analysis
REAL	Centre for Research in Education and Labour
REC	Research Ethical Clearance
SAICSIT	South African Institute for Computer Scientists and Information Technologists
SAJIM	South African Journal of Information Management
SALSA	Search, AppraisaL, Synthesis and Analysis
SAQA	South African Qualifications Authority
SEM	Structural Equation Modelling
SERVQUAL	Tool to measure service quality
SETA	Sector Education and Training Authority
SoC	School of Computing
SPSS	Statistical Software Package for Social Sciences
TAM	Technology Acceptance Model
TAM2	Technology Acceptance Model 2
TAM3	Technology Acceptance Model 3
TRATEC	Management Information System for TVET Colleges
TTF	Task-Technology Fit Model
TVET	Technical and Vocational Education and Training
UMALUSI	Council for Quality Assurance in General and Further Education and Training
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNISA	University of South Africa
US	User Satisfaction
USQAS	User Satisfaction with Question Answering System
UTAUT	Unified Theory of Acceptance and Use of Technology
UTAUT2	Unified Theory of Acceptance and Use of Technology 2
WAI	Weighted Average Index
WITS	Workshop of Information Technology and Systems

CHAPTER 1. INTRODUCTION

"If we knew what it was [that] we were doing, it would not be called research, would it?" – Albert Einstein[2]

1.1. Background to the study

The support and promotion of public Technical and Vocational Education and Training (TVET) Colleges is fundamental in addressing South Africa's intermediate-level and artisanal skills shortages as these contribute to the considerable unemployment rates in the country (Bhorat *et al*., 2014; Blustein *et al.*, 2017; DHET, 2015a; Menon, 2017; Reddy *et al.*, 2016; Stats SA, 2016, 2017). The college sector is seen as central to the provision of post-school education and training and these institutions have been earmarked by the South African government for extensive growth (DHET, 2014, 2015a; Nzimande, 2017).

It is the Department of Higher Education and Training's (DHET's) highest priority to strengthen and expand the public TVET Colleges (DHET, 2015a; Nzimande, 2017). The areas in need of attention include various aspects of which the improvement and development of Management Information Systems (MISs) is one (DHET, 2014, 2015a). Institutional short-term and long-term management decision-making and day-to-day operations at public TVET Colleges rely heavily on data and information outputs from their MISs. Public TVET Colleges' reports to the DHET are based on the information captured in their MISs and these have to be accurate for the DHET's strategic planning.

A *methodology* (artefact) for the evaluation of MISs deployed at public TVET Colleges will enable Information Technology (IT) specialists and MIS managers to perform rigorous and standardised MIS evaluations on a regular basis. Regular evaluations will promote timely identification of challenges in the system and enhance improved efficient and effective functioning of the MIS. It

[2] Source: http://www.alberteinsteinsite.com/quotes/einsteinquotes.html , accessed on 13 July 2017.

will furthermore contribute to improved quality and accuracy of data and information which, in turn, will inform and guide college management towards efficient and effective planning and decision-making for future direction concerning the college.

The rationale for the study is to develop a *methodology* (artefact) for the evaluation of a MIS at a public TVET College since no evidence of any *methodology* to evaluate MISs at public TVET Colleges in South Africa could be found in the literature. The *methodology* (artefact) can be regarded as a theory for design and action classified as a “Type V: Theory for Design and Action” by Gregor (2006, p. 628). The research design problem is how to develop a theoretically grounded *methodology* for the evaluation of MISs utilised by these institutions.

This theoretical framework will be presented as a *methodology* where the latter is defined as “a targeted construct that defines specific practices, procedures, and rules for implementation or execution of a specific task or function” Tomhave’s (2005, p. 9). This is consistent with the definition provided by Investigation Process Research Resource (IPRR) (2016) namely “a system of principles, practices, and procedures” applied to a specific branch of knowledge. A *methodology* is a mode of thinking, but it is also a mode of acting. It contains a number of concepts which try to describe the steps and relations needed in the process of creating and searching for new knowledge to solve problems (Arbnor & Bjerke, 2009). The mode of thinking refers to a specific paradigm and the mode of acting includes a strategy or plan of action which governs the choice and use of particular methods (Scotland, 2012).

The TVET-MIS-EVAL methodology (artefact) developed in this study for the evaluation of MISs at public TVET Colleges was developed by utilising a Design Science Research (DSR) approach. A comprehensive discussion of the DSR paradigm is provided in Chapter 2 (Research design and methodology). *Design Science Research* (DSR) is distinctly different from *Design Research* (DR). DR is a broad area spanning all design fields (applied disciplines) such as architecture, engineering, education, psychology and the fine arts (Cross, 2001) and does not include the defining feature of DSR which is *learning through building* artefacts. DR is research *into* or *about* design, whereas DSR mainly involves research using design as a research method or technique (Vaishnavi & Kuechler, 2015a). Through design science research, IT artefacts intended to solve problems identified in organisations are created and evaluated (Hevner, March, Park & Ram, 2004).

The study is informed by the Information Systems Research Framework presented by Hevner *et al.* (2004) and also employs the guidelines for DS in IS research (Hevner *et al.*, 2004). The conceptual framework for IS research is developed for understanding, executing and evaluating IS research and combines behavioural science and design science paradigms. Hevner *et al.* (2004) consolidate the technical or systems stream of IS research into a well-articulated design science paradigm – a problem solving paradigm for wicked problems. The research process of the study is informed by the Design Science Research Process (DSRP) model presented by Peffers *et al*. (2006). The theoretical framework of the artefact is informed by the Design Science Research Methodology (DSRM) as proposed by Peffers *et al*. (2008).

The design science paradigm is a problem solving paradigm which is proactive in the sense that it seeks solutions to problems through the creation and/or innovation of IT artefacts such as constructs, models, methods and instantiations (March & Smith, 1995; Hevner *et al.*, 2004; Goes, 2014).

Design science supports a pragmatic philosophical paradigm which considers thought as a tool for prediction, problem solving and action, and since the design science paradigm involves an interface between the natural and social worlds, it supports the critical realism philosophical approach (Hevner *et al.*, 2004; Hevner, 2007; Hevner & Chatterjee, 2010; Mingers, Mutch & Willcocks, 2013). The design science research process model (Peffers *et al.*, 2006, 2008) was followed to develop the artefact for this problem centred initiated study. The iterative process activities of the design science research process model namely: design, demonstrate, evaluate and communicate, contributed to the refinement of the artefact (*methodology)* (Peffers *et al.*, 2006, 2008). The developed *artefact* underwent experimental evaluation, which means that the artefact was evaluated in a controlled environment for its applicability (Hevner *et al.*, 2004). The *methodology* was empirically demonstrated and evaluated at three cluster-random selected public TVET Colleges. The sample of colleges was clustered into groups with similar website characteristics by using an innovative method.

To enable a systematic and scientific approach to the selection of a sample of public TVET Colleges, the 50 colleges were clustered based on the maturity level of their websites through the application of Web Maturity Models theory. The clustering technique produced three clusters of colleges. One college was randomly selected from each cluster on the assumption that each selected college would be representative of that specific cluster (cf. Chapter 7).

A *methodology* for the evaluation of a MIS at a public TVET College in South Africa was developed from examples of methodologies found in the literature and by applying hermeneutic principles (cf. Chapter 3). The developed *methodology* (which includes principles, guidelines, rules, practices, processes and approaches such as surveys and interviews) (cf. Chapter 6) was demonstrated and evaluated at the three selected cases (cf. Chapters 7 and 8). Quantitative data, supported by the post-positivist paradigm, and qualitative data and information, supported by the interpretivist paradigm, were gathered from each case during the demonstration and evaluation activities of the design science research process. Triangulation of quantitative and qualitative data was conducted to confirm or reject findings.

The following section illuminates the problem statement and purpose of the study.

1.2. Problem statement and purpose

The extent to which the South African government emphasises public TVET Colleges as institutions earmarked to contribute in addressing the critical shortages in intermediate skills in South Africa is highlighted in the previous section. The lack of intermediate and vocational skills has, in turn, been blamed as one of the major reasons for unemployment among the youth in South Africa (Graham & De Lannoy, 2017; Menon, 2017; Reddy et. al, 2016; Wijnberg, 2013; Williams, 2013). It is thus important that public TVET Colleges function optimally. For a college to function optimally, and thus respond rapidly to management issues and implemented changes, it requires a MIS which operates effortlessly and provides accurate and timeous information. It is therefore important to evaluate the success of MISs on a regular basis.

Evidence of many different MIS success evaluation models, which include combinations and extensions of existing models, was found in the literature. The following references attest thereto: Davis *et al.* (1989), DeLone and McLean (1992, 2003), Seddon and Kiew (1996), Seddon (1997), Venkatesh and Davis (2000), Dishaw *et al.* (2002), Petter *et al.* (2008), Gable *et al.* (2008), Venkatesh and Bala (2008), Freeze *et al.* (2010), Petter *et al.* (2013) and Mardiana, Tjakraatmadja and Aprianingsih (2015), to mention but a few. The research problem is that no evidence of a methodology for the evaluation of MISs at public TVET Colleges in South Africa could be found in the literature. Therefore, the rationale for the study is to develop a methodology to enable IT specialists and MIS managers at public TVET Colleges to evaluate MISs deployed at their colleges.

In sections 1.2.1 and 1.2.2 the research goal and rationale are respectively explicated, in section 1.2.3, the research goal is decomposed into research questions. In section 1.2.4, the objectives of the study are presented and the fields of investigation are delineated in section 1.2.5.

1.2.1. Research goal

The purpose of the study is to investigate and develop the components needed to assist in the development of a methodology to evaluate the MISs implemented at public TVET Colleges in South Africa. In order to reach this goal, it was necessary to investigate the following knowledge domains namely: theories and practices on the development of methodologies (cf. Chapter 3);

MIS success evaluation models (cf. Chapter 4); policies, procedures and government documentation on public TVET Colleges (cf. Chapter 5).

1.2.2. Rationale

Public TVET College managers need to respond promptly to challenging academic and environmental issues thereby enabling improved student performance and better pass rate outcomes. Continuous monitoring and evaluation of the MISs deployed at public TVET Colleges will support the improvement of MISs at these institutions. Improved functional MISs will contribute to timeous, accurate and enhanced data and information for management decision-making at the college and for reporting to the DHET for national strategic planning purposes. Public TVET Colleges do not have a *methodology* to evaluate their MISs on a regular basis and no evidence of any applicable methodology could be found in the literature.

1.2.3. Research questions

Based on the discussed background, problem statement and rationale, the main research question for this study is:

1.2.3.1 What are the components that constitute a methodology for the success evaluation of a MIS at a public TVET College in South Africa?

The following sub-research questions needed to be investigated to facilitate the investigation of the main research question:

1.2.3.2 What are the components of a methodology?

1.2.3.3 What models exist to support the success evaluation of MISs at public TVET Colleges?

1.2.3.4 What are the main characteristics of the research context and the MIS deployed at public TVET Colleges?

1.2.3.5 How do the results of the evaluation of the MISs at public TVET Colleges compare and contribute to the evaluation of the developed methodology (artefact)?

1.2.4. Objectives of the study

The objectives of the study, based on the main research question and the sub-questions presented in section 1.2.3, can be articulated as follows:

1.2.4.1 To review and interrogate the usefulness of existing literature on the components of a methodology and on methodology development.

1.2.4.2 To investigate existing MIS success evaluation models for use in developing the proposed methodology for evaluating MISs at public TVET Colleges.

1.2.4.3 To investigate the main characteristics of the public TVET College sector and the MISs deployed in these organisations.

1.2.4.4 To apply the developed methodology (artefact) to a selected sample of TVET Colleges.

1.2.5. Fields of investigation

As mentioned in section 1.2.1, there are three main knowledge domains that need to be investigated in order to address the main and sub-research questions effectively, namely:

- theories and practices about the development of methodologies;
- MIS success evaluation models;
- policies, procedures and government documentation on public TVET Colleges.

1.3. Theoretical grounding of the research

In this section a synopsis is given regarding the manner in which the literature review was approached and conducted; the theoretical framework that underpinned the study; and the processes utilised in the different phases of the study.

1.3.1. Literature review

A literature review is defined as "the use of ideas in the literature to justify the particular approach to the topic, the selection of methods, and demonstration that this research contributes something new" (Hart, 1998, p. 1). Hart (1998) also notes that a quality literature review should cover the topic in appropriate breadth and depth; should have rigour and consistency; should be clear and brief and should be effectively analysed and synthesised.

The aims of a literature review, according to Wellington, Bathmaker, Hunt, McCulloch and Sikes (2005, p. 87) are:

- To establish which of the problems identified for solution by means of empirical research has been solved by other researchers so that they can be removed from the research equation;
- To give readers a clear idea of the nature and context of one's research;
- To convince the reader of one's knowledge of the field; and
- To build a case for the empirical part of one's study.

A methodological review of extant literature is a crucial aspect of any research project and therefore it has to be governed by a systematic framework. An effective review provides a sound foundation for furthering knowledge. It enables theory development, illuminates areas where sufficient knowledge exists and exposes areas where more knowledge is required. A high-quality literature review is concept-centric and is considered complete when no new concepts in the relevant subject area under consideration are encountered. A complete literature review includes sources from all relevant journals, geographical areas and utilises more than one method (Webster & Watson, 2002; Levy & Ellis, 2006).

It is essential to acknowledge that not all literature published is of equal rigour. Therefore, one needs to validate the quality of literature before utilising it. Davison, Vreede and Briggs (2005) emphasise the importance of literature having been peer-reviewed and published in academic journals. Levy and Ellis (2006) support this view and argue that IS research literature from leading, peer-reviewed journals provide the necessary theoretical background and also leads to additional references on the topic. A comprehensive list of ranked MIS journals, as consulted in this study, can be found at https://aisnet.org/?JournalRankings.

Another valuable scientific source of IS research literature is conference proceedings. Since not all conference proceedings are subjected to the same quality peer-review processes, it is important to select resources carefully. One should focus on conferences run by reputable research or professional associations such as AIS, ACM, INFORM, IEEE, AOM, ISI and DSI, and also consult reference lists of journal articles published in leading peer-reviewed journals for referenced conference proceedings (Levy & Ellis, 2006). An extensive list of ranked conferences, as used in this study, can be found at http://www.wi2.fau.de/_fileuploads/research/generic/ranking/information_technology.html.

Figure 1.1 depicts the stages of an effective literature review, as adapted from Levy and Ellis (2006, p. 182).

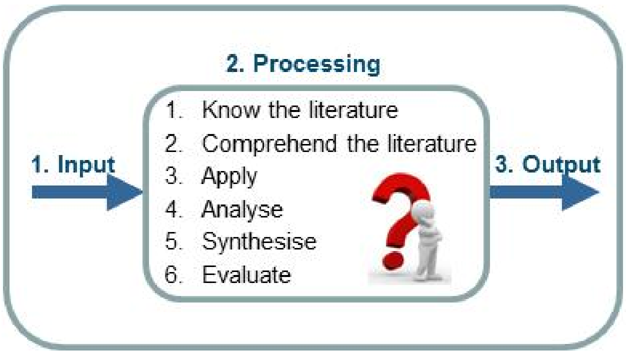


Figure 1.1. Stages of an effective literature review process (Levy & Ellis, 2006, p. 182).

The first stage in a literature review is concerned with collecting data and information (input) where keywords are extracted from a defined problem statement (research question) to serve as a filter for the identification of relevant literature (Klopper, Lubbe & Rugbeer, 2007). Grant and Booth (2009) use a simple analytical framework, which they call, Search, AppraisaL, Synthesis and Analysis (SALSA) to evaluate different types of reviews. The SALSA framework corresponds with the stages suggested by Levy and Ellis (2006) in Figure 1.1. Fourteen review types in a typology of reviews are identified by Grant and Booth (2009). The review types and associated methodologies were analysed against the SALSA framework and characterised by the methods used. The review types include the following: critical review, literature review, mapping review/systematic map, meta-analysis, mixed studies review/mixed methods review, overview, qualitative systematic review/qualitative evidence synthesis, rapid review, scoping review, state-of-the-art review, systematic review, systematic search and review, systematised review and umbrella review. This study made use of most of these review types at different levels and stages of the research, for example overviews, literature reviews and scoping reviews were used to initiate literature searches, which were then followed up by more in-depth mixed studies reviews or mixed methods reviews.

Figure 1.2 maps the main and sub-research questions with the corresponding knowledge domains of this study from which the relevant keywords for literature searches have been identified.

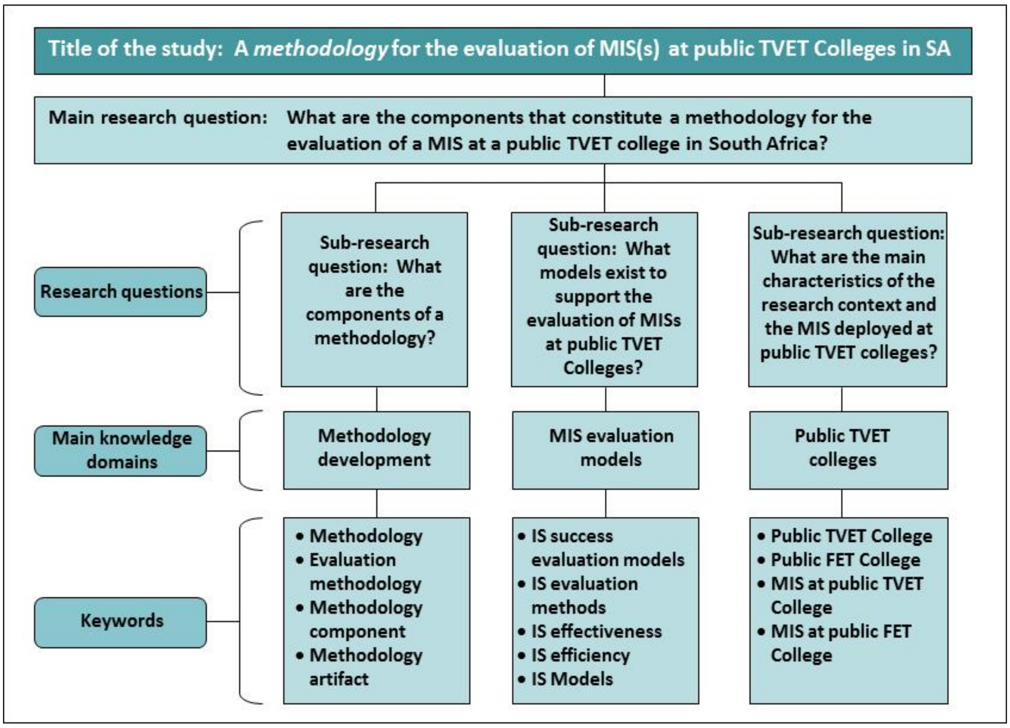


Figure 1.2. Framework for the systematic literature overview of the study.

One approach to systematic literature studies, as suggested by Klopper *et al.* (2007, p. 9), is to build a concept matrix of literature sources. The constructed matrix should be functional since it is a process which relates more to the personal creativity, proficiency and originality of the researcher than to rules and principles. Earlier versions of literature survey matrices will furthermore have to be modified as understanding of the research topic grows (Klopper, Lubbe & Rugbeer, 2007, p. 9).

The literature overview of the study commenced by searching through journal databases using the identified keywords, thereafter the searches evolved to include forward and backward searching. By moving beyond keyword searches and following backward and forward searches, one is able to follow historical lines, models, theories, theoretical constructs and research streams (Levy & Ellis, 2006, p. 190). Table 1.1 provides a summary of the literature review techniques which were utilised in the study.

Table 1.1. Literature review techniques utilised in the study (Webster & Watson, 2002; Levy & Ellis, 2006).

Technique	Description
Keyword search	An effective *keyword search* provides initial insight into the subject domain (Levy & Ellis, 2006). The keywords, as depicted in Figure 1.2 for each knowledge domain, were used to search journal databases such as Taylor & Francis, EBSCO, JSTOR, ProQuest, ABI/INFORM, etc. for relevant literature to the study.
Backward searches include: • Backward reference search • Second level backward reference search • Backward authors search • Previously used keywords	*Backward references search* refers to the reviewing of references of the literature that was yielded through the initial keyword searches. A *second level backward reference* search was also conducted by reviewing the references of references found in the initial keyword search results. *Backward authors search* refers to searches of work produced by authors which were found in the references of the literature attained through initial keyword searches. *Previously used keywords search* is a technique that uses main keywords located in the literature, which were acquired through initial keyword searches. These keywords were then used to conduct further keyword searches.
Forward search • Forward reference search • Forward author search	*Forward references search* refers to reviewing literature that cited the literature yielded from initial keywords searches. *Forward authors search* refers to the reviewing of literature that was produced by the authors of the obtained literature.

The following section provides information about the theoretical framework which underpins the study.

1.3.2. Philosophical paradigms

Philosophy involves thinking about the problem under consideration in a rigorous and questioning manner by formulating arguments for ideas and meeting arguments against them. Thus, a philosophy consists of a particular set of ideas about knowledge, truth, the nature and meaning of life as well as a set of ideas about how to do something (Webster, 2015). It is furthermore acknowledged that communities from different research philosophical paradigms have different ideas and views about the nature of reality (ontology), about what constitutes valid research (methodology), about how to gain or create knowledge (epistemology) and about what is of value (axiology).

The three main approaches to research are the qualitative, quantitative and mixed methods approaches (Greene, 2006; Johnson, Onwuegbuzie & Turner, 2007; Creswell & Plano Clark, 2011) and they can briefly be explained as follows:

- The qualitative approach refers to the understanding of human behaviour and the reasons that govern such behaviour;
- The quantitative approach refers to systematic empirical investigation of quantitative properties and phenomena and their relationships; and
- The mixed methods approach includes the mixing of qualitative and quantitative approaches to the type of data, methods, methodologies, and/or paradigms in a research study or set of related studies.

Qualitative and quantitative research has different approaches to the type of data, methods, methodologies, and/or paradigms. Philosophical ideas must therefore be combined with broad approaches to research (strategies) and implemented with specific procedures (methods) (Creswell, 2003). Thus, a framework is needed for a study to combine the elements of philosophical ideas, strategies, and methods into the three approaches (quantitative, qualitative or mixed methods) to research (Creswell, 2003). A framework is defined as a “fundamental construct that defines assumptions, concepts, values, and practices, and that includes guidance for implementing itself” (Tomhave, 2005, p. 9).

Based on Crotty’s (1998) ideas the following four questions should be considered when establishing the theoretical framework of a research study:

- What epistemology or theory of knowledge embedded in the theoretical perspective, informs the research (e.g. objectivism, subjectivism)?
- What theoretical perspective or philosophical stance lies behind the methodology in questions (e.g. positivism and post-positivism, interpretivism, critical theory, design science, structuralism)?
- What methodology, strategy or plan of action that links methods to outcomes, governs our choice and use of methods (e.g. experimental research, survey research, ethnography)?
- What methods, techniques and procedures do we propose to use (e.g. questionnaire, interview, focus group)?

Creswell (2003, p. 5) conceptualises Crotty’s model to the following three questions:

- What knowledge claims are being made by the researcher (including a theoretical perspective)?
- What strategies of inquiry will inform the procedures?
- What methods of data collection and analysis will be used?

Information systems is an applied discipline in the sense that it applies theories from other disciplines (such as business, economics, computer science and social sciences) to address problems located in the intersection between information technology and organisations (Peffers *et al.*, 2008). All the literature reviewed is in agreement regarding information systems research being multi-disciplinary and multi-paradigmatic in nature, and generally utilising mixed-methods, also called multi-methodologies, in its conduct (Lucas, 1983; Nunamaker, Chen & Purdin, 1991; Mingers, 2001, 2003b; Galliers, 2003;

Venable, 2008; Hevner & Chatterjee, 2010; Gregor & Hevner, 2013; Mingers, Mutch & Willcocks, 2013; Vaishnavi & Kuechler, 2015b).

Literature studies revealed that positivism, interpretivism, pragmatism, critical realism, constructivism, design science and behaviourism are the most prominent philosophical paradigms in IS research. Therefore, these philosophical paradigms were studied and considered for this study. Comprehensive information about these paradigms, along with their specific assumptions, is presented in Chapter 2 (cf. Table 2.1). The framework underpinning the information presented in Table 2.1 is informed by Goldkuhl (2012, p. 12) and the content is based on contributions from different authors including Orlikowski and Baroudi (1991), Mingers (2003a), Goldkuhl (2004, 2008, 2012), Hevner *et al.* (2004), Howcroft and Trauth (2004), Weber (2004), Hevner (2007), Creswell (2008), Mastin (2008), Myers and Klein (2011), and Mingers *et al.* (2013).

Consideration of the different paradigms, in combination with the philosophy behind the study, revealed that the most suitable paradigms for this study is design science (which involves building-and-evaluating artefacts) supported by pragmatism (which is a problem-solving paradigm). Thus, the study was conducted according to the design science philosophical paradigm supported by pragmatism, as extensively explained in Chapter 2. The study also employed methods utilised by interpretivists and post-positivists during the demonstration and evaluation of the developed artefact.

1.3.3. Theoretical framework of the study

The information systems research framework, as presented by Hevner *et al*. (2004), in which behavioural science (problem space-environment: people, organisation, business, planned and existing technologies) and design science (designing and developing of artefacts to address the identified need) are combined and support design science research activities (development of artefacts), underpins the theoretical framework of the study, as explained in

Chapter 2. The information systems research framework, as suggested by Hevner *et al.* (2004, p. 80), is depicted in Figure 1.3.

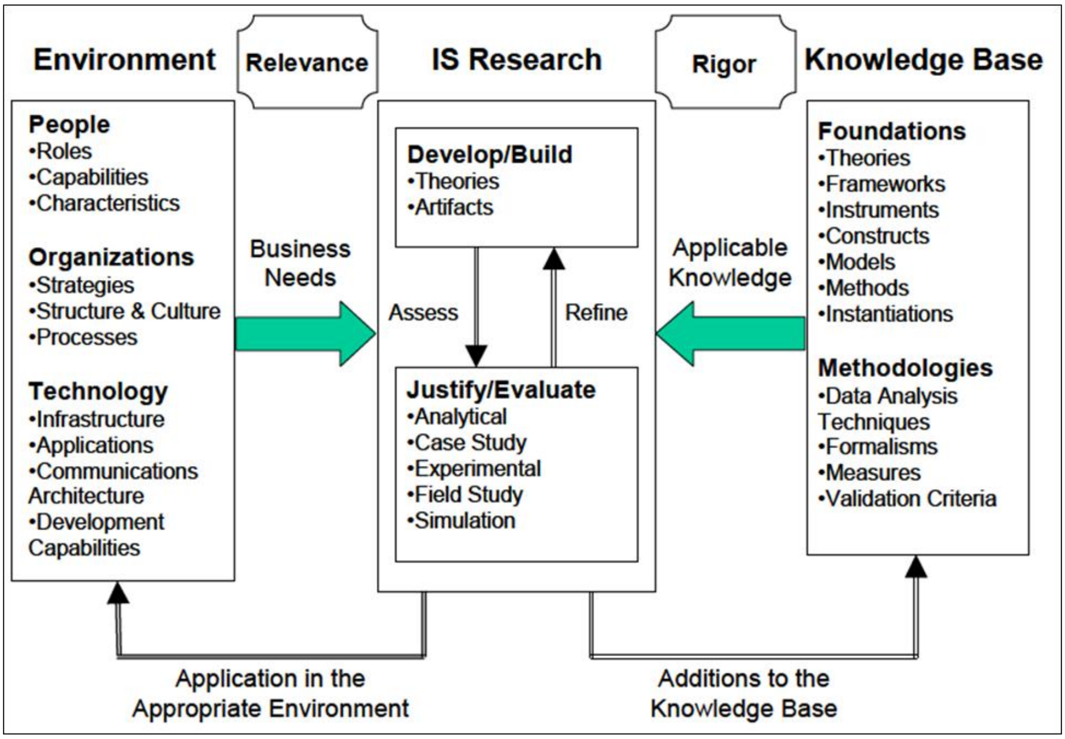


Figure 1.3. Information systems research framework (Hevner *et al.*, 2004, p. 80).

The development of the methodology (artefact) of the study, within the context of public TVET Colleges, was conceptually guided by existing literature, while following specifications and guidelines for creating artefacts in the design science research paradigm. The research process of the study was informed by the activities described by Peffers *et al.* (2006) in the design science research process (DSRP) model.

The matrix in Table 1.2 relates the sub-research questions of the study to the design science research process (DSRP) model activities, the data gathering methods and the data analysis methods used to collect and analyse both the data and information which support the probing of the main research question.

Table 1.2. Sub-research questions by strategy, type of data collection instrument and data analysis method used.

Research question		Design Science Research process model activity	Data gathering methods					Data analysis method
Main research question	**1.2.3.1 What are the components that constitute a methodology for the evaluation of a MIS at a public TVET College in South Africa?**		**Literature review, documents**	**Structured questionnaires**	**Unstructured and semi-structured interviews and audiotapes**	**Observations and photographs**	**Anecdotal records**	
Sub-question 1	1.2.3.2 What are the components of a methodology? (cf. Chapter 3)	• Objectives of a solution; • Design and development.	√					Qualitative, Hermeneutics
Sub-question 2	1.2.3.3 What models exist to support the evaluation of MISs at public TVET Colleges? (cf. Chapter 4)	• Objectives of a solution; • Design and development.	√		√		√	Qualitative, Hermeneutics
Sub-question 3	1.2.3.4 What are the main characteristics of the research context and the MIS deployed at public TVET Colleges? (cf. Chapter 5)	• Problem identification and motivation; • Objectives of a solution; • Design and development.	√	√	√		√	Qualitative, Hermeneutics
Sub- question 4	1.2.3.5 How do the results of the evaluation of the MISs at public TVET Colleges compare and contribute to the evaluation of the developed methodology? (cf. Chapter 8)	• Demonstrate; • Evaluate; • Communicate.	√	√	√		√	Quantitative and qualitative

1.3.4. Research process

The design science research process (DSRP) model for producing and presenting information systems research, as suggested by Peffers *et al.* (2006), underpins the research process of the study, which addresses the research problem. The research process of the study is illustrated in Figure 1.4 and extensively explicated in Chapter 2 (cf. section 2.5). The shaded part of Figure 1.4 situates this chapter.

The research process of the study consists of the following phases:

Phase 1: In this phase the study is introduced, the background to the study, problem statement, purpose and research questions are presented (Chapter 1). This phase relates to the first activity in the DSRP model, proposed by Peffers *et al.* (2006), which is: *identify problem and motivation of relevance*.

Phase 2: Description of the research design and methodology of the study (Chapter 2).

Phase 3: This phase corresponds to the second DSRP model activity (Peffers *et al.*, 2006), which is: *define objectives of a solution*. Literature studies were conducted with the aim of informing the development of the required artefact (*methodology)* for the evaluation of a MIS at a public TVET College in South Africa. Theories and information about the development of a methodology (cf. Chapter 3); models for the evaluation of MISs (cf. Chapter 4) and MISs at public TVET Colleges (cf. Chapter 5) are provided in this phase.

Phase 4: *Design and development,* presents the third activity in the DSRP model (Peffers *et al.*, 2006) and involved the design and development of the required artefact which was named the *TVET-MIS-EVAL methodology* (cf. Chapter 6). The findings from Chapters 3, 4 and 5 were used to design and develop the artefact.

Phase 5: A sample of cases was selected based on an innovative evidence-based cluster-random selection technique (cf. Chapter 7). The colleges were clustered based on their level of MIS maturity. Three cases were selected, one from each cluster.

Phase 6: The developed artefact (named the TVET-MIS-EVAL *methodology*) was *demonstrated* as per the fourth activity in the DSRP model (Peffers *et al.*, 2006) and *evaluated* as per the fifth activity in the DSRP model (Peffers *et al.*, 2006) by using the selected cases as part of the iterative build-and-evaluate processes within the DSRP model to refine and evaluate the designed and developed TVET-MIS-EVAL methodology. Data collection, analysis and reporting were conducted as part of the processes in the iterative refinement of the artefact. Refinements to the developed TVET-MIS-EVAL methodology (artefact) are presented in Chapter 8.

Phase 7: Documentation of findings, discussion and conclusion are presented, which corresponds to the sixth and final activity in the DSRP model (Peffers *et al.*, 2006) which is *communication of results* (cf. Chapter 9).

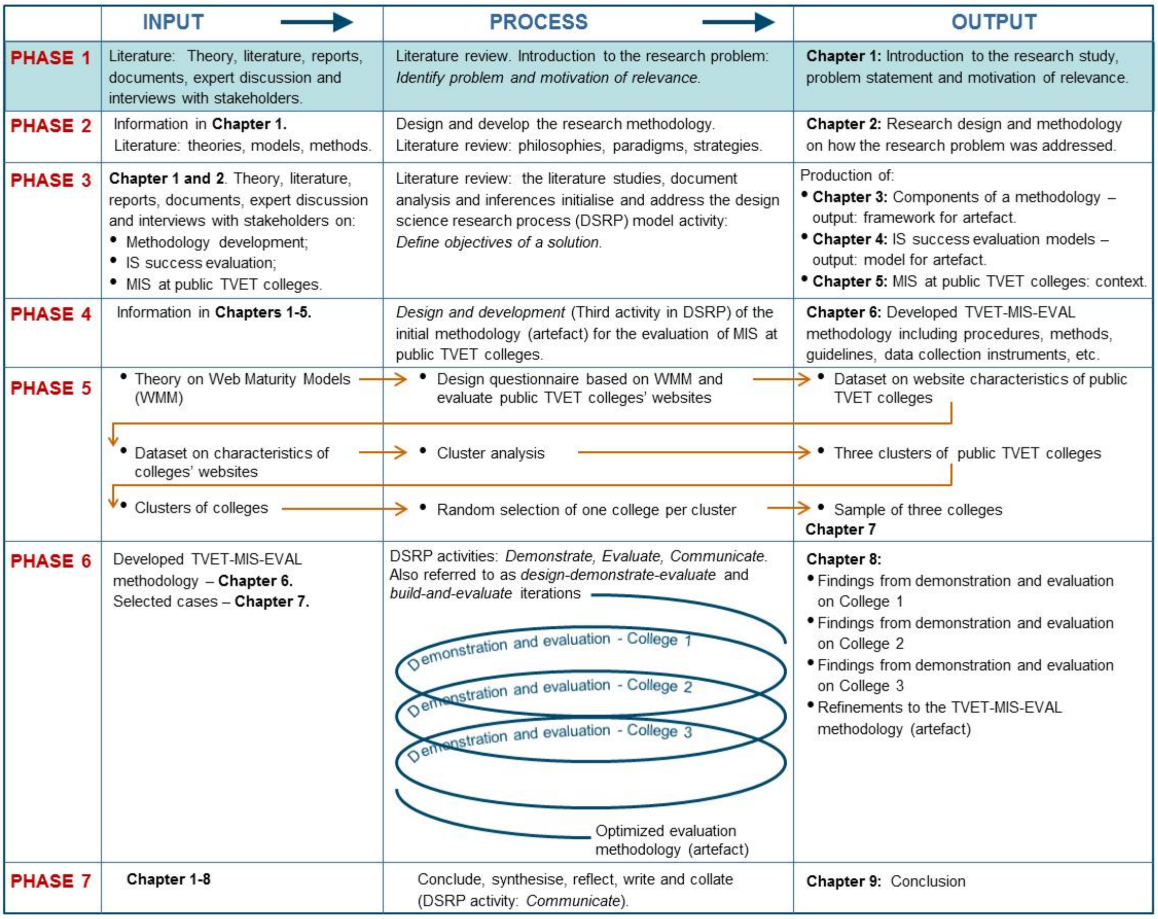


Figure 1.4. Research process of the study delineated by phases, inputs, activities and outputs, underpinned by the design science research process (DSRP) model (Peffers *et al.*, 2006, p. 93).

1.4. Importance and relevance of the study

Relevance is defined as being pertinent, having direct bearing (Oates, 2006). The question is: relevant to whom? The common assumption is relevant and important to practitioners (Oates, 2006). This study contributes to the academic knowledge domain by providing a methodology for the evaluation of a MIS at a public TVET College, but also contributes to the world of the practitioner by providing practical repeatable methodological steps in the conduct of MIS evaluation at public TVET Colleges. It is furthermore acknowledged that theory is applied in a multitude of ways by researchers and practitioners, and there are important differences in the purpose and the application of theory, as depicted in Table 1.3 (Galletta & Zhang, 2006, p. 4).

Table 1.3. Framework for Applying Theory.

	The Academic researcher	**The practitioner**
Goals	Generalisation	Problem solving
Activities	Theory development and testing	System design and evaluation

Source: (Galletta & Zhang, 2006, p. 4)

Both MIS researchers and practitioners are interested in the organisational context. That context provides a notion of an organisation's strategic goals and users' tasks. For researchers, the organisational context drives the choice of research problems and suggests methods for learning more. In a similar way, for practitioners, the organisational context bounds the problems that are being examined and leads to approaches for solving them (Galletta & Zhang, 2006). The differentiating factor is that researchers are most often interested in acquiring generalisable knowledge, while practitioners are focused on providing a solution to the organisation, with the aim of improved competitive advantage and efficient and effective functioning of the organisation.

In this study, the primary intention with the development of the methodology for the evaluation of MISs at public TVET Colleges in South Africa is to contribute theory to the IS knowledge domain in the form of a rigorous, standardised and generalisable artefact that can be used by practitioners. The artefact can be used to enhanced efficiency and effectiveness of (firstly) the functioning of the MIS at college level and (secondly) it can add to the strength of the desired quality of data and information for decision-making by management in the organisational structure of the public TVET Colleges, thus strengthening the reporting of the college to the DHET for national strategic planning.

The remainder of this section provides information about sampling, data collection, scientific rigour, ethical considerations and citation management and reporting.

1.4.1. Sampling and data collection

The first instance of sampling involved the selection of cases for the evaluation of the newly designed and developed artefact. Instead of convenient and purposive sampling strategies, which are the most commonly used strategies in qualitative research where cases need to be selected, this study utilised an innovative evidence-based cluster-random sampling strategy to select a sample of colleges on which the developed artefact could be evaluated. This was done to ensure a scientific, systematic and a more rigorous sample selection process.

Considering the focus of the study, the evaluation of MISs at public TVET Colleges, the aim was to use empirical evidence to cluster the colleges in such a way that colleges with similar levels of MIS maturity could be grouped together. Since no information about MISs deployed at public TVET Colleges could be found in the literature, it was decided to use a proxy variable for the level of MIS maturity and thereafter utilise the proxy in the evidence-based clustering process. Many sources noting the links between capability maturity levels of organisations and website maturity levels were found in the literature (Paulk *et al*, 1993; Rhoads, 2008; Fath-Allah *et al*, 2014; UBC, 2015). The decision was made to base the clustering of colleges on the colleges' website maturity levels. The question still remained: *How can information about a college's website maturity be found?*

Web Maturity Models (WMM) is a mature research field as discussed in Chapter 7. Based on the WMM literature an evaluation questionnaire was developed (cf. Figure 7.2 and Appendix H). The evaluation questionnaire was presented as a capturing template using Microsoft Access 2010 software. The capturing tool was then used by nine evaluators to evaluate the websites of the 50 public TVET Colleges. Inter-rater reliability of the nine evaluators was established with the calculation of Intraclass Correlation Coefficients.

Hierarchical and Non-Hierarchal Cluster Analysis (TwoStep) were used to cluster the population of public TVET Colleges based on the website evaluation scores. Inferential statistics were calculated by using the Statistical Package for the Social Science version 24 (IBM SPSS Statistics 24).

Three groups emerged from the analysis:

- colleges without a website or websites on a low maturity level (Cluster 1);
- colleges with websites which achieved an average score, at first impression, as regards structure, appearance, navigation and ease of finding specific functionality as well as the comprehensiveness and usefulness of content and information regarding programmes offered and application and registration procedures at the college (Cluster 2); and
- colleges that meet user experience and usability satisfaction requirements as well as information requirements and comprehensive functionality in terms of number of components available (Cluster 3).

One college was randomly selected from each cluster as representative of the cluster. Thereafter a process, via telephone and email communication, was initiated in an effort to gain access to the selected colleges. Approval from the Chief Executive Officer (CEO) or Principal was acquired after which a contact person was appointed (cf. Appendix B). The developed methodology (artefact) was iteratively demonstrated and evaluated at the selected sample of colleges.

As part of the evaluation of the artefact, the entire populations of MIS users at the selected public TVET Colleges were surveyed (quantitative data). In addition, the sampling of participants for structured and unstructured interviewing was purposive, as the participants included Department of Higher Education and Training (DHET) officials, MIS and IT managers at the selected public TVET Colleges, as well as a sample of MIS users at the college (qualitative data).

Data was collected by utilising the following strategies:

- Qualitative data and information from literature reviews, document analysis and other relevant documents were gathered to inform and assist in the design and development of the methodology (artefact).
- Quantitative and qualitative data and information were sourced from the three case studies during the evaluation of the artefact.
- Surveys, in which all users of the MISs at the three respective public TVET Colleges participated, were conducted. Here mainly quantitative methods from a post-positive philosophical paradigm were used.
- Unstructured and semi-structured interviews were held with IT and MIS managers at the public TVET Colleges, and with other stakeholders including DHET officials. This qualitative method falls in an interpretive philosophical paradigm.

A survey instrument (cf. Appendix E) was designed and developed as part of the methodology (artefact) and used to collect data from MIS users. A semi-structured interview schedule (cf. Appendix D) was also designed and developed as part of the methodology (artefact) and utilised to gather information from key persons at the college including the CEO or Principal, MIS and IT managers, data manager and MIS service provider.

The collected data and information underwent exploratory and inferential statistical analysis (cf. Chapter 8). The quantitative data analysis included exploratory analysis such as frequencies, ranges, means and variances, and inferential statistical procedures including tests for consistency, scale reliability (Cronbach's alpha), unidimensionality (Principal Component Analysis) and linear regression analysis. Qualitative data analysis was conducted through coding and categorisation into themes.

Quantitative results, obtained from the empirical demonstration and evaluation of the methodology (artefact) at the selected cases, were triangulated with qualitative information from interviews. The final results were compared across institutions. The qualitative data capturing and analysis was used in explaining and contextualising the quantitative findings. Findings for each case and a synthesis of findings across cases - similarities and differences - were documented and discussed as part of the refinement of the *methodology* (artefact).

1.4.2. Final developed methodology

The designed and developed *methodology* (artefact), which consists of principles, practices, rules, guidelines and procedures, for the evaluation of a MIS at a public TVET College was refined by the results of the demonstration and evaluation activities on three cluster-random selected colleges. The final product of the study was a *methodology,* which contributes to filling the gap in the literature on theorising MIS evaluation at vocational and skills training colleges.

1.4.3. Scientific rigour

Scientific rigour encompasses both systematic conduct and validity (Oates, 2006). The study was undertaken in a rational and systematic manner with logical relationships existing between the different tasks. Validity was acquired by utilising appropriate research processes, conducting data analysis of actual empirical data gathered from the field and reporting on findings from data analysis to address the research questions. This study is underpinned by the design science research paradigm which incorporates practices of the pragmatic philosophical paradigm. The study utilised the following design science theories in its conduct: the design science research methodology (Peffers *et al.*, 2008), guidelines (Hevner *et al.*, 2004), processes (Peffers *et al.*, 2006) and communication schema (Gregor & Hevner, 2013).

1.4.4. Ethical consideration

Application forms for ethical clearance supplemented with the research proposal and survey instruments (questionnaire and interview schedule), were completed and submitted (on 24 October 2014) to the research ethical clearance (REC) committee of the University of South Africa (UNISA) where the researcher is a registered student (Application number: 183/MMV/2014). Ethical clearance for the research study was granted on 16 January 2015, by the

College of Science, Engineering and Technology's (CSET) research and ethics committee, which forms part of the University of South Africa (UNISA) (cf. Appendix A).

1.4.5. Citation management and reference method

References for the study were managed electronically with the Zotero referencing tool. Zotero citation management tools for different computer platforms are free and downloads are available on the internet (Zotero, 2015). To ensure consistency the Harvard method of referencing (Harvard reference format 1 author-date) was used throughout the thesis.

1.5. Contribution

According to Davis (2005, p. 18), a theoretical contribution to design science research theory should include a "developed and demonstrated new or improved design of a conceptual or physical artefact". "The contribution may be demonstrated by reasoning, proof of concept, proof of value added, or proof of acceptance and use" (Davis, 2005, p. 18).

Knowledge contributions can be divided into two related types: descriptive and prescriptive knowledge. Descriptive knowledge includes the accumulation of descriptions about natural, artificial, social, or human phenomena and the relationships between and among these phenomena, while prescriptive knowledge concerns artefacts designed by humans to improve the natural world (Gregor & Hevner, 2013). March and Smith (1995) define four types of prescriptive knowledge or design theories: constructs, models, methods, and instantiations, which is described in detail in section 2.4.1.

A design science research study can make different types of research contributions on different levels depending on its "starting points in terms of *problem maturity* and *solution maturity*" (Gregor & Hevner, 2013, p. 344). It is for that reason that Gregor and Hevner (2013) presented a DSR knowledge contribution framework in a two-by-two matrix (cf. Figure 1.5) in their study on positioning and presenting design science research for maximum impact. Each quadrant in the matrix describes the contextual starting points of the research in terms of problem and solution knowledge foundations (Gregor & Hevner, 2013).

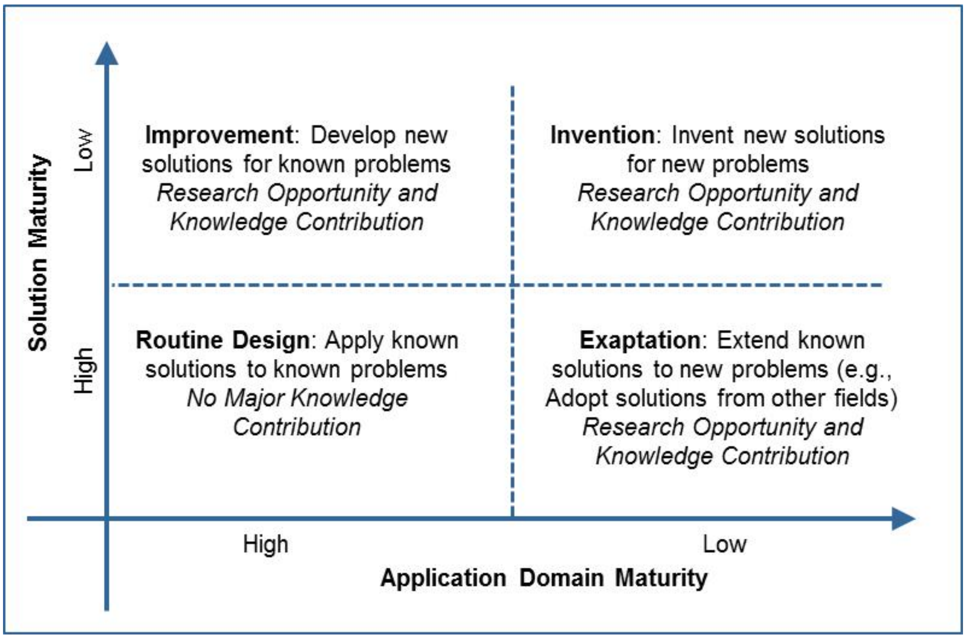


Figure 1.5. DSR knowledge contribution framework (Gregor & Hevner, 2013, p. 345)

Since no evidence of any methodology for the success evaluation of a MIS at a public TVET College in South Africa could be found in the literature, the artefact can be considered as a new solution. Therefore, the theoretical contribution of this research study resonates with the quadrant of an *improvement* when the artefact is considered as a new solution to a known problem and with the quadrant of an *invention* when the artefact is considered as a new solution to a new problem.

The main theoretical contribution made by this research study was the evaluated *methodology* (artefact), which can be regarded as a theory for design and action classified as “Type V: Theory for Design and Action” by Gregor (2006, p. 628). The artefact is described in detail in Chapter 6. The study furthermore, contributed to the extant literature on MIS success evaluation by adding to the theory on measuring of MIS success constructs and measuring of the relationships between MIS success constructs: Systems quality, Service quality, Information quality, User satisfaction, Individual impact and

Organisational impact. A comprehensive discussion and explanation of the empirical evidence, which contributed to the academic literature on MIS success evaluation is provided in Chapter 8.

Practically the developed artefact contributes to the educational environment by enabling IT specialists and MIS and data managers at public TVET Colleges to evaluate the MIS deployed at their institutions. The novelty of the research lies in the production of a *methodology* (artefact) to evaluate a MIS in the context of an educational domain. The artefact satisfies the conditions of importance, parsimony and novelty and contributes to micro-level theories (Weber, 2012).

The utilisation of the developed methodology (artefact) can practically contributed to, firstly, the quality of the MIS deployed at a public TVET College and, secondly, to the quality of the data and information produced by the MIS for reporting to the DHET. Enhanced decision-making by college management can contribute to enhanced efficiency and effectiveness of the public TVET College. It would also be possible to apply the developed methodology to all public TVET Colleges, since the artefact is generalisable within the public TVET College domain.

In terms of its policy significance, the developed *methodology* (artefact) can assist in generating public evidence to increase accountability and allow for improvement in service delivery systems. It can indirectly, by enhancing data quality, provide valuable information to decision-makers at both local college and national DHET level on which type of interventions should be implemented for effective improvement of educational outcomes for public TVET College students in South Africa. Findings from applying the *methodology* (artefact) could furthermore assist policy-makers and programme managers in identifying gaps, strengths and weaknesses in management information systems deployed at public TVET Colleges.

The evidence-based innovative clustering method, by which the population of public TVET Colleges was clustered as described in detail in Chapter 7, was an additional contribution to the knowledge domain. The method is generalisable to other knowledge domains and disciplines where case study approaches are applicable.

1.6. Delineations, limitations and assumptions

The study can be demarcated as follows:

- The study was conducted in the South African context within the public TVET College domain and therefore the methodology (artefact) is not generalisable to other countries.
- The artefact was designed and developed based on the design science research philosophical paradigm.
- Only one college was randomly selected from each of the clusters. The assumption was that each selected college was representative of the cluster from which it was selected. Since the designed and developed methodology (artefact) was iteratively evaluated and refined by demonstrating and evaluating it at the three selected colleges, it can be assumed that the methodology is generalisable across all public TVET Colleges in South Africa.
- The innovative evidence-based statistical clustering method developed and used in the study can be generalised to other contexts due to its reliance on evidence.
- All concepts defined within the developed artefact (*methodology*) were viewed from a *MIS success evaluation* perspective and not from a *human computer interaction* (HCI) perspective.

1.7. Future research

The following suggestions for future research could be proposed:

- This study could be extended by testing the developed methodology (artefact) at similar contexts in other countries.
- Future research could also focus on further refinements to the developed methodology (artefact) especially to the *guidelines*, *rules*, *procedures* and *toolkit* components of the methodology.

- Investigation into comparisons of the results from applying the methodology to different types of colleges could provide insight into the effects of different college management structures and styles.
- The artefact could be applied at a college at different time periods, for instance in cycles of every two years to observe changes in the measurements. Causes for changes could also then be investigated.

The following three sections respectively provide the research plan followed in conducting the study, a summary of, and a chapter map for the thesis.

1.8. Research planning

The research plan delineated by stages and time lines are presented in Table 1.4. It shows the spread of activities from December 2014 to September 2017.

Table 1.4. Proposed research plan and data collection schedules for the study.

Stages in implement-tation	**Activities**	**Parties involved**	**Instrument applied**	Des 2014	Jan 2015	Feb 2015	Mar 2015	Apr 2015	May 2015	Jun 2015	Jul 2015	Aug 2015	Sep 2015	Oct 2015	Nov 2015	Dec 2015	Jan 2016	Feb 2016	Mar 2016	Apr 2016	May 2016	Jun 2016	Jul 2016	Aug 2016	Sep 2016	Oct 2016	Nov 2016	Dec 2016	Jan 2017	Feb 2017	Jul 2017	Aug 2017	Sep 2017
Stage 1: Ethical clearance for the study	Application for research ethical clearance (Chapter 1). (Ethical clearance was granted on 16 January 2015.)	Study Leaders, Research conductor, UNISA	Application forms																														
Stage 2: Research methodology	Drafting of the research design and methodology chapter (Chapter 2).	Study Leaders, Research conductor	Literature review, Personal interviews																														
Stage 3: Clustering of 50 public TVET Colleges for sample selection	Conceptual framework for sample selection. Website evaluation of TVET Colleges. Literature review on clustering methods. Sample selection (Chapter 7).	Study Leaders, Research conductor	Literature review, Personal interviews																														
Stage 4: Literature review	Critical literature review of literature related to the design and development of the required artefact (Chapters 1, 3, 4 and 5).	Study Leaders, Research conductor	Literature review, Personal interviews																														
Stage 5: Development of the *methodology*	Use building blocks established through literature reviews to develop the methodology (Chapter 6).	Study Leaders, Research conductor	Literature review, Personal interviews																														
Stage 6: Fieldwork preparation	Contacting of selected public TVET Colleges for permission to use their college as a case study (part of Chapter 2).	Study Leaders, Research conductor	Telephonic and email communi-cations																														

Stages in implement-tation	**Activities**	**Parties involved**	**Instrument applied**	Des 2014	Jan 2015	Feb 2015	Mar 2015	Apr 2015	May 2015	Jun 2015	Jul 2015	Aug 2015	Sep 2015	Oct 2015	Nov 2015	Dec 2015	Jan 2016	Feb 2016	Mar 2016	Apr 2016	May 2016	Jun 2016	Jul 2016	Aug 2016	Sep 2016	Oct 2016	Nov 2016	Dec 2016	Jan 2017	Feb 2017	Jul 2017	Aug 2017	Sep 2017
Stage 7: Actual fieldwork	Data collection phase - visit selected public TVET Colleges and apply the initial developed *methodology* as part of the evaluation of the artefact (Chapter 8).	Study Leaders, Research conductor, TVET Colleges	Survey questionnaire and interviews																														
Stage 8: Data analysis and refinement of the methodology	Analyse and interpret the quantitative and qualitative data to inform refinements to the *methodology* (Chapter 8).	Study Leaders, Research conductor	Qualitative and quantitative data analysis methods. Statistical software. MS Access 2010, SPSS version 24, MS Excel 2010.																														
Stage 9: Final optimised methodology	Suggestions for refinements towards the developed methodology (Chapter 8).	Study Leaders, Research conductor	Synthesis of findings																														
Stage 10: Conclusion, reflection and synthesis	Thesis writing (Chapter 9).	Study Leaders, Research conductor	Synthesis of chapters																														
Stage 11: Language editing and formatting	Appointment of language editor and language editing of thesis (Chapters 1-9).	Study Leaders, Research conductor																															
Stage 12: Finalisation and submission of thesis	Finalisation of thesis (Chapters 1-9).	Study Leaders, Research conductor																															

1.9. Summary

The support and promotion of public TVET Colleges is essential in addressing South Africa's intermediate-level and artisanal skills shortages as these contribute considerably to the unemployment rates in South Africa. These institutions have been earmarked by the South African government for extensive growth. Therefore, the evaluation of their MISs, which in turn, informs their institutional short-term and long-term management decision-making and day-to-day operations, should take place on a regular basis. Regular evaluations will contribute to the efficient and effective functioning of the MIS and improved accuracy of data and information output reports from the system to inform and guide managers towards management decision-making.

The problem is that no evidence of a *methodology* (artefact) to evaluate MISs at public TVET Colleges in South Africa could be found in the literature. Hence, the rationale for this study is to develop a methodology (artefact) for the evaluation of MISs at public TVET Colleges in South Africa. The main research question for the study was therefore formulated as: *What are the components that constitute a methodology for the evaluation of a MIS at a public TVET College in South Africa?*

The aim of the study was to construct a conceptual theoretical framework that informs the design and development of a *methodology* (artefact) by using existing knowledge and trends in the field of information systems evaluation and methodology development, and taking into account the requirements of South African policy with regard to the administration and functioning of public TVET Colleges.

The study is underpinned by the design science research paradigm and incorporates practices and principles of the pragmatic philosophical paradigm. The process of the study was informed by the design science research process (DSRP) model for IS (Peffers *et al.*, 2006). The demonstration, evaluation and communication activities in line with the DSRP model contributed to the refinement of the *methodology* (artefact). The *methodology* (artefact) underwent experimental evaluation which means that the artefact was evaluated in a controlled environment for its applicability (Hevner *et al.*, 2004). Empirical evaluation of the *methodology* (artefact) was iteratively conducted at three public TVET Colleges. The colleges were randomly selected from clusters after all colleges had been clustered by using an innovative evidence-based clustering technique. The use of the evidence-based clustering technique enhanced rigorous and robust sample selection.

The main contribution to the knowledge domain was the *methodology* (artefact as outcome through design science research) that can support IT practitioners and MIS managers at public TVET Colleges in South Africa to evaluate their MISs on a regular basis.

The study contributed to an improved understanding of the components needed to develop a *methodology* (artefact) for the evaluation of MISs at public TVET Colleges in South Africa.

1.10. Chapter map for the thesis

The structure of the thesis is underpinned by the *publication schema* for IS research, as presented by Gregor and Hevner (2013, p. 350), and summarised by Goes (2014, p. vi). Table 1.5 links the sections of the publication schema for IS research to the chapters of the study.

Table 1.5. Chapter map according to publication schema for a Design Science Research (DSR) Study.

Publication schema (Gregor & Hevner, 2013, p. 350)		**Chapter in this study**
Section	**Contents**	
Introduction	Problem definition, problem significance/motivation, introduction to key concepts, research questions/objectives, scope of study, overview of methods and findings, theoretical and practical significance, structure of remainder of paper/thesis. For DSR, the contents are similar, but the problem definition and research objectives should specify the goals that are required of the artefact to be developed. Claims for contribution to practice and knowledge or theory must be made in this section.	Chapter 1

Publication schema (Gregor & Hevner, 2013, p. 350)		**Chapter in this study**
Section	**Contents**	
Method	This section contains the method utilised where research rigour is fundamental and the research approach that was employed is illuminated. For DSR work, the specific DSR approach adopted should be explained with reference to existing authorities.	Chapter 2
Literature review	Prior work that is relevant to the study, including theories, empirical research studies and findings/reports from practice. For DSR work, the prior literature surveyed should include any prior design theory/knowledge relating to the class of problems to be addressed, including artefacts that have already been developed to solve similar problems.	Chapter 3 Chapter 4 Chapter 5 Chapter 7
Artefact description	A concise description of the artefact at the appropriate level of abstraction to make a new contribution to the knowledge base. This section (or sections) should occupy the major part of the paper. The format is likely to be variable but should include at least the description of the designed artefact and, perhaps, the design search process.	Initial artefact in Chapter 6 and optimised artefact in Chapter 8
Evaluation	Evidence that the artefact is useful. The artefact is evaluated to demonstrate its worth with evidence addressing criteria such as validity, utility, quality and efficacy.	Chapter 8
Discussion	Interpretation of the results: what the results mean and how they relate back to the objectives stated in the Introduction section. Can include: summary of what was learned, comparison with prior work, limitations, theoretical significance, practical significance and areas requiring further work. Research contributions are highlighted and the broad implications of the paper's results to research and practice are discussed.	Chapter 9
Conclusion	Concluding paragraphs that restate the important findings of the work. Restates the main ideas in the contribution and why they are important.	Chapter 9

The following chapter presents the research design and methodology utilised in this study to design and develop the required artefact.

CHAPTER 2. RESEARCH DESIGN AND METHODOLOGY

2.1. Introduction

Descriptions of the identified research problem and the motivation of the relevance thereof were dealt with in Chapter 1. The research design and methodology applied to address the research problem is presented in this chapter. This chapter, therefore, describes the methodology used to design and develop the required artefact, which is a product of the study.

The philosophical assumptions that underpin the research study (including the principles, procedures, research strategies, sampling strategies, data collection and data analysis techniques applied to address the research questions) are discussed in this chapter. The justification for the selected research methodologies, based on the background to the study, is also presented in this chapter.

The chapter is structured as follows: it commences with a description of the philosophical assumptions, the research paradigm and the theoretical background of the study in sections 2.2, 2.3 and 2.4, respectively. The research process of the study, including the methods and processes utilised within each phase of the process, is presented in section 2.5. Data collection methods, data analysis methods, ethical consideration and the conclusion are provided in sections 2.6, 2.7, 2.8 and 2.9, respectively.

2.2. Philosophical assumptions of the study

Creswell notes that "philosophically, researchers make claims about ***what*** is knowledge (ontology), ***how*** we know it (epistemology), what values go into it [(***why***)] (axiology), ***how*** we write about it (rhetoric), and the processes for studying it (methodology)" (1994, p. 6).

Philosophical assumptions consist of assumptions that underpin all research studies (Creswell & Plano Clark, 2011). These assumptions shape how the researcher sees the world and acts in it. This set of assumptions forms a framework that guides the researcher's actions (Denzin & Lincoln, 2011). The authors state that the researcher is bound to assumptions that form a framework guiding his/her actions. They suggest that all research is "guided by the researchers' set of beliefs and feelings about the world and how it should be understood and studied" (Denzin & Lincoln, 2008, p. 31). As the context and purpose of the research define the methodological foundation of the study, it is advisable for researchers to be familiar with the different approaches.

The assumptions of the study, which were considered during the construction of the research design and methodology, are described in section 2.2.1 to section 2.2.5.

2.2.1. Ontological assumptions

(What constitutes reality and how can we understand existence? The nature of reality.)

This study centred on the need within the public TVET College sector for a methodology to evaluate the success of the management information system (MIS) deployed at the college. Thus, an artefact had to be designed and developed to support this function within the public TVET College sector. The study had to include views of stakeholders such as DHET officials, MIS managers and users, and IT managers within TVET Colleges. The reality was complex and multi-faceted resulting in the researcher having to be subjective in some cases and objective in others. For instance, the researcher had to be subjective when considering the reality of the design of the artefact and objective when dealing with the reality of the evaluation and demonstration of the artefact.

The researcher had to make use of extant literature to design and develop the methodology (artefact) to evaluate the success of the MIS at a public TVET College. The applicability of the artefact had to be demonstrated and evaluated.

2.2.2. Epistemological assumptions

(What constitutes valid knowledge and how can we obtain it? The relationship between the researcher and what is being researched.)

In this study, valid knowledge included the interpretation (through the use of the hermeneutic circle) of literature which, in turn, formed the foundation on which the artefact was built. This knowledge was sourced from multiple disciplines. It was envisaged that new knowledge would contribute to the knowledge domain in terms of, firstly, the knowledge about the creation of the artefact and, secondly, research knowledge generated through the artefact's construction, demonstration and evaluation. The researcher had to assume the role of inventor or experimenter.

2.2.3. Axiological assumptions

(The role of values.)

The researcher acknowledges that the study was value-laden and that biases might have played a role in the interpretation of the literature (hermeneutics) and in data analyses' results. The researcher also acknowledges that her values could have influenced her interpretation, despite her best efforts to provide evidence-based findings. The researcher utilised the hermeneutic circle, as applied to literature reviews, in the design and development of the artefact. A survey and interviews were utilised to generate primary data during the demonstration and evaluation of the artefact. Quantitative data were analysed by using exploratory and inferential statistics.

2.2.4. Rhetorical assumptions

(Language of the research.)

The researcher utilised the language of qualitative and quantitative research. The voice of the researcher was expressed as a collaborator and critical researcher.

2.2.5. Methodological assumptions

(Research process.)

An investigation into any suitable method for the design and development of an artefact, which had to be practically applicable for the evaluation of the success of a MIS at a public TVET College, was conducted. The information systems research framework, as presented by Hevner *et al.* (2004), constituted a suitable underpinning theoretical framework for the study. Methods from both the pragmatist and design science paradigms were used to design and development the artefact. Methods from interpretivist and post-positivist paradigms were incorporated into the artefact itself.

The following section provides information regarding the motivation for the philosophical paradigm adopted for the study.

2.3. Philosophical paradigms

A philosophical paradigm is an overarching perspective concerning appropriate research practice based on paradigm-specific assumptions, including: ontological; epistemological; axiological; rhetoric and methodological assumptions. It thus relates to the development of knowledge and the nature of that knowledge (Saunders, Lewis & Thornhill, 2009). In science and the theory of knowledge (epistemology), a paradigm is a distinct set of concepts or thought patterns, including theories, research methods, assumptions, and standards for what constitutes legitimate research and valid contributions in a given study (Oates, 2006; Creswell & Plano Clark, 2011; Scotland, 2012). In order to conduct and evaluate any research, it is therefore important to know what these assumptions for the different paradigms are. Selected philosophical paradigms with their specific assumptions were reviewed and are presented in Table 2.1.

Literature studies revealed that the most prominent philosophical paradigms in IS research are positivism, interpretivism, pragmatism, critical realism, constructivism, design science and behaviourism. Therefore, these philosophical paradigms were studied and synthesised in Table 2.1. The framework presented in Table 2.1 is informed by Goldkuhl (2012) and the content is based on contributions from different authors including: Orlikowski and Baroudi (1991), Mingers (2003a), Goldkuhl (2004, 2008, 2012), Hevner *et al.* (2004), Howcroft and Trauth (2004), Weber (2004), Hevner (2007), Creswell (2008), Mastin (2008), Myers and Klein (2011), and Mingers *et al.* (2013).

Based on the given philosophical assumptions of the study, as presented in section 2.2.1 to section 2.2.5, and the literature review on paradigms, as synthesised in Table 2.1, the study fits within the design science philosophical paradigm. Design science research focuses on creation or innovation with the aim of solving identified problems (problem-solving paradigm). The purpose of design is “to change existing situations into preferred ones” (Simon, 1988, p. 67). Design science addresses “wicked problems” in information systems research (Rittel & Webber, 1973, 1984). As explained by Hevner and Chatterjee (2010, p. 11) “wicked problems” relate to ill-defined environmental contexts which need creativity and teamwork to produce effective solutions.

Design science is problem-solving in nature, it incorporates pragmatic approaches and utilises multiple methods. For pragmatists, the *problem* is of more importance than the *methods used* and researchers may thus employ any suitable approach towards understanding or solving the problem. This study has adopted a design science philosophical paradigm which is supported by pragmatic approaches to find a solution to what the components of a methodology for the success evaluation of a MIS at a public TVET College in South Africa are (cf. Chapter 1, section 1.2.3.1).

A comprehensive discussion about the design science philosophical paradigm and how it was used in this study is presented in section 2.4, which elucidates the theoretical background of the study.

Table 2.1. Philosophical assumptions of the reviewed paradigms of IS research.

	Positivism	Interpretivism	Pragmatism	Critical realism	Constructivism	Design Science	Behaviourism
Ontology	Person (researcher) and reality are separate. Determination. Reductionism. Empirical observation and measurement. Theory verification.	Person (researcher) and reality are inseparable (life-world). Constructivism Interpretivism is dependent on constructivist ontology.	Consequences of actions. Problem centred. Pluralistic. Real-world practice oriented. Symbolic realism. Practical consequences or real effects vital components of both meaning and truth.	Conceptualise reality as complex and recognise the role of both agency and structural factors in influencing human behaviour. People have ability to change their circumstances but are constrained by prevailing systems.	Learning (cognition) is the result of 'mental construction'. Own understanding is constructed by reflecting on interdependent parts of a whole combined with personal experiences, by relating the new knowledge with what is already known. One of its main principles is that learning equals the search for meaning. It refers to how humans make meaning in relation to the interaction between their experiences and their ideas.	Addresses research through the building and evaluation of artefacts designed to meet the identified need.	Behaviourism holds that mental states are just descriptions of observable behaviour and that such behaviours can be described scientifically without recourse either to internal physiological events or to hypothetical constructs such as the mind. Addresses IS research through the development and justification of theories that explain or predict phenomena related to identified need.
Empirical focus	Objective reality exists beyond the human mind. Natural scientist imposes external logic (meaning-constructs) on the data.	Subjective. Knowledge of the world is intentionally constituted through a person's lived experience. Beliefs and intentions (socially constructed cognition).	Objective and subjective. Actions and changes.	Subjective. Challenge forms of behaviour and prevailing systems and structures.	Subjective. Internal process of constructing meaning from new knowledge in relation with own experience. Hermeneutics.	Subjective. Proactive - Problem solving, creation and innovation. Focus on context and process of studied IS phenomenon.	Objective. The belief that all mental phenomena can be explained by reference to publicly observable behaviour. Focus on human behaviour. In IS research it is reactive – artefact is given in context of business environment.
Type of knowledge	Explanation.	Understanding the subjective meanings of persons in studied domain.	Constructive knowledge: Explanation, understanding, prescriptive, normative, prospective.	Understanding and constructive knowledge.	Making meaning and learning by interpreting the parts to be able to understand and interpret the whole.	Seek utility. Understanding. Present solutions through design of systems and IT artefacts.	Explaining and truth finding.
Role of knowledge	Theory verification.	Interesting, derived from hermeneutics, phenomenology and anthropology.	Useful for action, improvement of human condition with more effective and profitable relations with objects in future.	Useful for action, improvement of human condition.	Useful for action, improvement of human condition.	Useful for action, improvement of human condition.	Understanding of phenomena through observable human behaviour.
Type of investigation	Experiments, Case study	Field study.	Inquiry, impulse, perception, manipulation, consummation.	Mixed methods.	Field study, linguistics.	Mixed-methods.	Field study, human behaviour, case study.

	Positivism	Interpretivism	Pragmatism	Critical realism	Constructivism	Design Science	Behaviourism
Data generation	Statistics. Data through interpretation through survey, questionnaire, experiment, simulation.	Data through interpretation through interviews, ethnography, hermeneutics, phenomenology, grounded theory.	Data through assessment and intervention (mixed-methods).	Data through conceptual study, case study, ethnographic field research.	Data through case study and own experiences.	Data through building and evaluating IT artefacts (mixed-methods).	Data through interpretation of human behaviour in for instance field study.
Role of researcher	Passive, observation, understanding.	Engaged in understanding.	Engaged in change.	Engaged in change.	Engaged in finding the meaning of the whole by investigating the interdependent parts of the whole and combining it with own experiences.	Engaged in change.	Engaged in understanding.

The following section provides information about the theoretical background that underpins the study.

2.4. Theoretical background of the study

Before the methodology of the study could be designed, it was important to know and understand the methods, procedures and paradigm governing design science (DS) research. The following section provides information about the design science paradigm.

2.4.1. Design Science paradigm

A literature review was conducted on design science research within the information systems discipline to gain a deeper understanding of design science research. A synthesis of significant historical events in the life of design science research, which was initiated and known as *Computing and Information Technology* (CIT) in the 1940s, is presented in chronological order in Table 2.2. The progress in design science research theory, as noted in Table 2.2, evidently confirms that design science is an established paradigm in information systems research.

Table 2.2. Significant events in the history of Design Science Research (DSR) in the Information Systems (IS) discipline.

Year	Significant events in DSR in IS	Source
1940s	Advent of the Computing and Information Technology (CIT) field. CIT field has taken over many of the ideas, concepts and methods of design science that originated in other disciplines such as architecture, engineering, education, psychology and the fine arts.	(Hevner & Chatterjee, 2010)
1969	First publication of *The Sciences of the Artificial* which describes objects and phenomena – artefacts – that result from human intervention in the natural world.	(Simon, 1996)
1970s	The Information Systems (IS) field emerged and since then knowledge grew regarding the design, creation and development of information systems or IT artefacts and this became an important stream of IS research. Throughout the years *design science* has been referred to as *technical, systems-oriented* IS research.	(Goes, 2014)
1983	Iivari (1983) referred to *design science* as *systemeering* in his book entitled: Contributions of the theoretical foundations of	(Iivari, 1983)

Year	Significant events in DSR in IS	Source
	systemeering research and the PIOCO model (Acta Universitatis Ouluensis). The author characterises Information Systems or Data Processing Science as an applied science.	
1990/ 1991	Recognition within the IS community regarding the importance of design science research to improve the effectiveness and utility of the IT artefact in the context of solving real-world business problems. The Workshop of Information Technology and Systems (WITS) was established as a pre-ICIS workshop. ICIS started in 1980. WITS provided a forum and an identity for advancing knowledge in the technical IS area. Ground-breaking research by Nunamaker *et al.* (1991) and his Electronic Group Decision Support System (GDSS) team about the definition of design science, and how to theorise and actualise it in the IS field. The authors used the terms *systems development* and *engineering approach* to refer to *design science*. Nunamaker *et al.* (1991) propose a framework or model for contextualising the role of systems development in IS research.	(Nunamaker, Chen & Purdin, 1991; Hevner & Chatterjee, 2010; Goes, 2014)
1995	March and Smith (1995) identify two design processes (build and evaluate) and four types of design artefacts (constructs, models, methods and instantiations) in design science research.	(March & Smith, 1995)
1996	The third edition of Simon's book, *The Sciences of the Artificial,* was published. Simon's work underpinned the framework for IS research as presented by Hevner, March, Park and Ram (2004).	(Simon, 1996; Hevner *et al.*, 2004; Hevner & Chatterjee, 2010)
2001	Orlikowski and Iacono (2001) underline the need for IS design science research – call for an exploration and theorising of the IT artefact that underlies all IS research.	(Orlikowski & Iacono, 2001)
2004	Hevner *et al.* (2004) consolidate the technical/systems stream into a well-articulated design science paradigm – a problem solving paradigm for *wicked* problems. The authors acknowledged that the roots of the design science paradigm is in engineering and the sciences of the artificial from Simon's (1996) work. Contribution to the knowledge domain includes: • Information Systems Research Framework. • Guidelines for understanding, executing and evaluating design science in Information Systems research. • The authors elaborate on the broad definitions of the IT artefacts, as identified by March and Smith (1995), which matched the main sub-streams of the WITS community.	(Simon, 1996; Hevner *et al.*, 2004; Goes, 2014)

Year	Significant events in DSR in IS	Source
2006	Peffers *et al.* (2006) develop a design science research process (DSRP) model that would meet three objectives: • It would be consistent with prior literature; • It would provide a nominal process model for doing DS research; and • It would provide a mental model for presenting and appreciating DS research in IS.	(Peffers *et al.*, 2006)
2006	Venable (2006) presents a framework and context for design science research *activities* adapted from Nunamaker *et al.* (1991) and Venable and Travis (1999).	(Venable, 2006)
2006	Gregor (2006) proposes a taxonomy that classifies information systems theories according to the way in which four central goals are addressed: analysis, explanation, prediction and prescription. Five interrelated types of theory are distinguished: • Theory for analysing; • Theory for explaining; • Theory for predicting; • Theory for explaining and predicting; and • Theory for design and action. Design Science research is classified within the latter type of theory – theory for design and action. It is about *how to do* something. This type of theory is about the "principles of form and function, methods, and justificatory theoretical knowledge that are used in the development of IS" (Gregor, 2006, p.628).	(Gregor, 2006)
2007	Hevner (2007) presents a *Three Cycle View of Design Science Research:* relevance cycle, design cycle and a rigour cycle.	(Hevner, 2007)
2007	The ontology, epistemology, methodology and ethics of design science as a paradigm are discussed. A need for constructive research methods, which allow for the disciplined, rigorous and transparent building of IT artefacts as outcomes of design science research, is expressed.	(Iivari, 2007)
2008	Peffers *et al.* (2008) motivate, present, demonstrate in use and evaluate a methodology for conducting design science (DS) research in information systems (IS).	(Peffers *et al.*, 2008)
2011	Kuechler and Vaishnavi (2011) design and present an *informing system* for Design Science Research with the aim of addressing the relevance gap between academic research and the world of practice.	(Kuechler & Vaishnavi, 2011)
2013	Piirainen and Gonzalez (2013) infer, through comparison, that Design Science Research (DSR) and the Constructive Research Approaches (CRA) are compatible and that CRA could be seen as a sub-sample of DSR.	(Piirainen & Gonzalez, 2013)
2013	A *DSR knowledge contribution framework* with two dimensions based on extant knowledge in the problem and solutions domains and a *DSR communication schema* are developed and examined via DSR exemplar publications.	(Gregor & Hevner, 2013)

Year	Significant events in DSR in IS	Source
2015	Chatterjee (2015) provides insight on how to make a theoretical contribution to DSR by addressing the following two questions: • Where should we theorise in DSR? • How do we holistically approach theory development in the sciences of the artefact?	(Chatterjee, 2015)
2016	Drechsler and Hevner (2016, p. 5) extended the well-known three-cycle view for design science research with a fourth cycle namely, the *change and impact cycle*, which captures the dynamic nature of IS artefact design for volatile environments.	(Drechsler & Hevner, 2016)

It is furthermore important to discuss the types of artefact that have been identified and developed in design science (DS) research. March and Smith (1995) identified four types: *constructs*, *models*, *methods* and *instantiations*. These types of artefact, including an additional type namely a *design theory***,** were further researched and explained by researchers including: Chatterjee (2015), Cleven, Gubler and Hüner (2009), Gregor (2006), Gregor and Hevner (2013), Herselman and Botha (2016), Hevner and Chatterjee (2010), Hevner, March, Park and Ram (2004), Vaishnavi and Keuchler (2015a) and Venable (2006).

In this study, a *methodology* as an artefact has been designed, developed, constructed, demonstrated and evaluated.

Brief definitions of the mentioned artefacts are as follows:

- *Constructs*: Constructs are terms that are utilised to describe elements of the problems and/or solutions. It includes vocabulary and symbols and offers syntax and semantics to describe the problem and/or the solution. It includes, for example, classification systems, language standards and ontologies (Hevner *et al.*, 2004; Cleven, Gubler & Hüner, 2009; Herselman & Botha, 2016).
- *Models*: A model is an abstraction or representation of reality. By making use of models, relationships between construct elements can be explained and certain aspects of reality can be abstracted, for example

through meta models or reference models (Hevner *et al.*, 2004; Cleven, Gubler & Hüner, 2009).

- *Methods*: A method is a set of steps to guide the execution of a task. Methods represent algorithms, practices and proceedings for the solution of specific problems or classes of problems, for example approaches for business process modelling or software development (Hevner *et al.*, 2004; Cleven, Gubler & Hüner, 2009; Herselman & Botha, 2016).
- *Instantiations*: An instantiation represents a concrete realisation of a construct, model or method. It refers to implemented prototypes. The feasibility and effectiveness of constructs, models or methods are demonstrated and this enables researchers to actually test their concepts in the real world and learn more about the real world (Hevner *et al.*, 2004; Cleven, Gubler & Hüner, 2009; Herselman & Botha, 2016).
- *A design theory*: "…is an abstract, coherent body of prescriptive knowledge that describes the principles of form and function, methods, and justificatory theory that are used to develop an artefact or accomplish some end." (Gregor & Hevner, 2013, p. A3). *Design theory* can include the other forms of design knowledge, which are: *constructs, models, methods,* and *instantiations* that convey knowledge. DS research can contribute to the improvement of existing theories or the formulation of new theories. Gregor (2006) distinguishes between five different types of theory in the area of IS research namely: (1) theory for analysing, (2) theory for explaining, (3) theory for predicting, (4) theory for explaining and predicting, and (5) theory for design and action. In general, theories describe cause and effect relations (Venable, 2006; Kuechler & Vaishnavi, 2011; Gregor & Hevner, 2013).
- *Methodology*: A methodology comprises a philosophical paradigm which includes a *philosophical* dimension, with basic beliefs and assumptions about the world, and a *technical* dimension which incorporates the methods and techniques adopted when applying the methodology. Thus, a methodology represents the philosophical underpinning of a paradigm, as well as the methods and techniques, and how they are used by the artefact (methodology) (McGregor & Murnane, 2010). An extensive literature review about methodologies is provided in Chapter 3.

2.4.2. Theoretical framework of the study

The information systems research framework, as presented by Hevner *et al.* (2004), underpins the theoretical framework of the study. In the theoretical framework, as proposed by Hevner *et al.* (2004), behavioural science and design science are combined and support design science research activities in producing *design and action* theories (Gregor, 2006). Hevner *et al.*'s information systems research framework was briefly discussed in Chapter 1, section 1.3.3.

Figure 2.1 presents the theoretical framework of the study, which was informed by the IS research framework suggested by Hevner *et al.* (2004). Figure 2.1 illustrates that the relevance of the research is motivated by a business need within the public TVET College environment. A *methodology* (artefact) to evaluate the success of the management information systems at public TVET Colleges encompasses the business need.

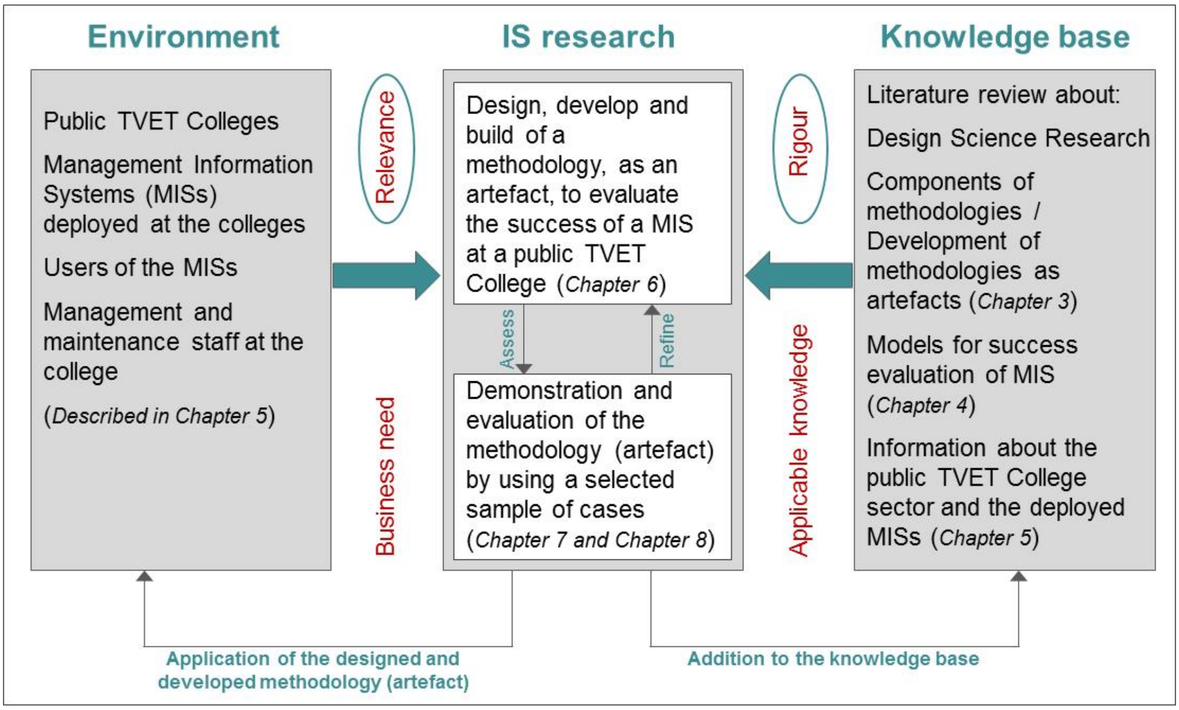


Figure 2.1. Theoretical framework of the study, informed by Hevner *et al.* (2004, p. 80).

The rectangle in the middle of the Figure 2.1 depicts design science research in which an artefact is designed, developed and constructed. An important aspect of design science research includes the evaluation of the developed artefact, which is illustrated in the bottom of the rectangle in the middle. Figure 2.1 also shows that knowledge from the knowledge base is utilised to design, develop and build the artefact, ensuring a rigorous development process as well as a rigorous artefact. The framework furthermore shows that the results, or outputs, from the design science research contribute to the business environment as well as to the knowledge base. It produces a rigorous artefact that can be applied in the specific environment, the public TVET College sector. Secondly, research information about the design and development of the artefact contributes academic knowledge to the knowledge domain. The chapters where the different components of the framework were described are provided in Figure 2.1.

Hevner (2007) describes the development of an artefact in design science research within the information systems research framework, by referring to a three-cycles design view, which includes the *relevance*, *rigour* and *design* cycles as depicted in Figure 2.2.

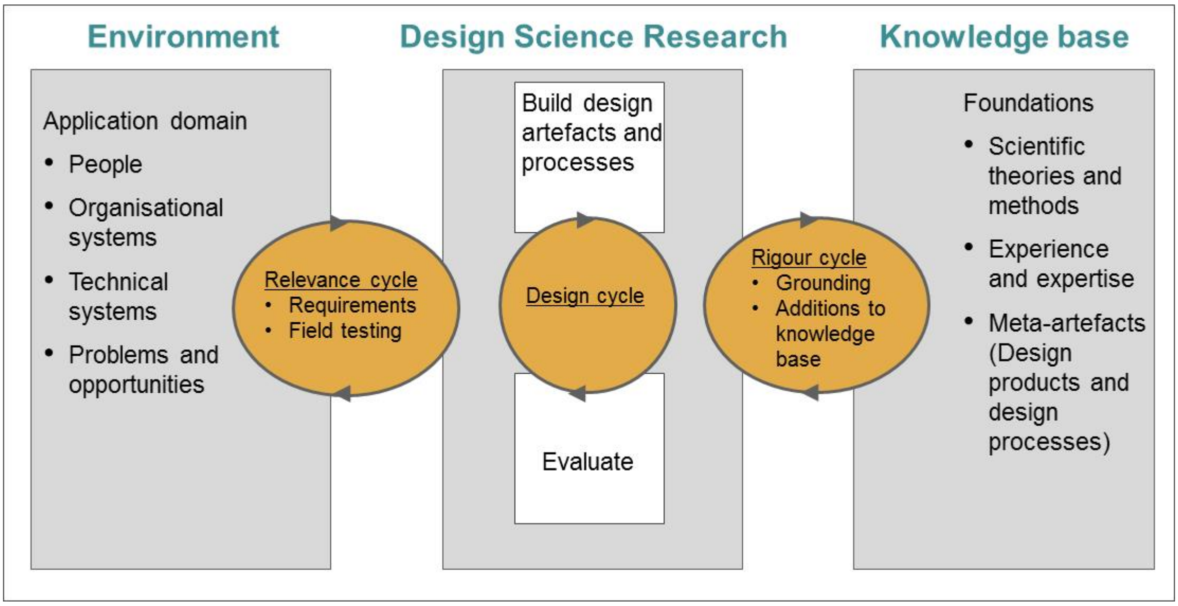


Figure 2.2. Design science research cycles (Hevner, 2007, p. 88).

The public TVET Colleges consisting of people, organisational and technical systems, from which the research problem was identified, represent the *relevance cycle*. The existing literature represents the *rigour cycle* which is embedded in the knowledge base and which informed the design and development of the methodology (artefact). The artefact was designed, developed, constructed and evaluated in the *design cycle,* in which the other two cycles interact.

Drechsler and Hevner (2016) extended the three-cycle view for design science research with a fourth cycle, the *change and impact cycle*, which captures the dynamic nature of IS artefact design for volatile environments (cf. Figure 2.3).

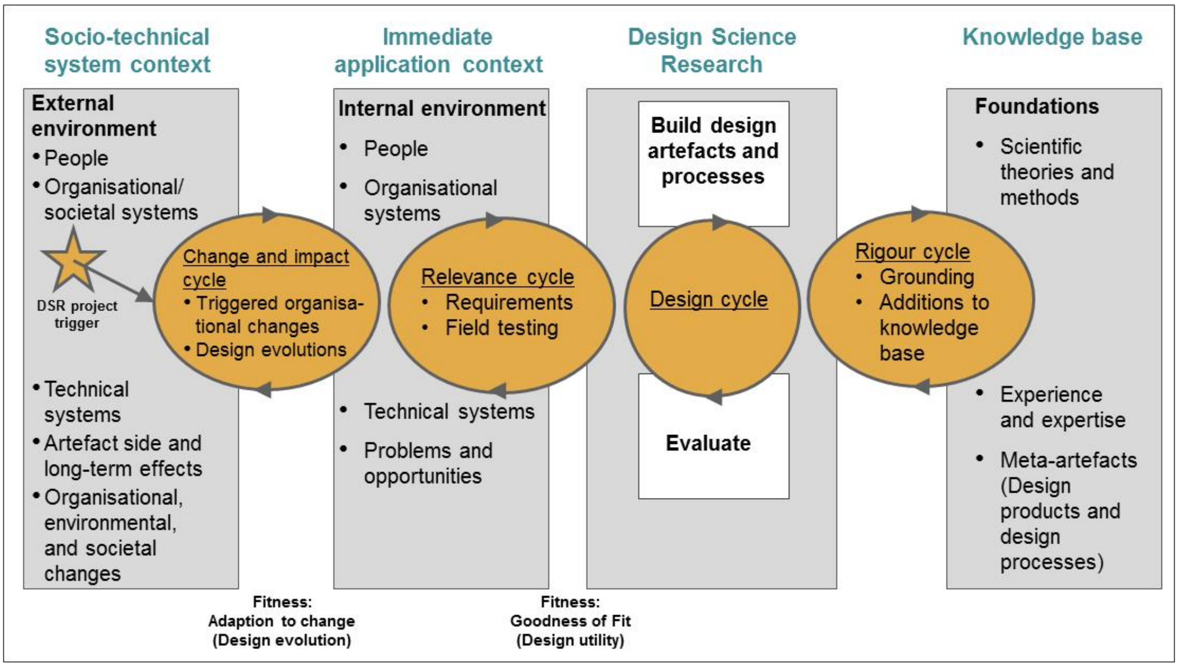


Figure 2.3. A four-cycle view of design science research (Drechsler & Hevner, 2016, p. 5).

The broader contexts that can be affected by the developed artefact (methodology), which relates to the *change and impact* cycle, include the management of the public TVET College, the Department of Higher Education and Training (DHET) and the country. It is envisaged that the methodology (artefact) can contribute to the improvement of MISs at public TVET Colleges, which can assist in more informed decision-making at college level. Improved MISs can further support improved quality of data in reporting of college statistics to the DHET which can, in turn, enable the DHET to conduct enhanced planning to support skills development in the country and ultimately cause a reduction in unemployment rates.

2.4.3. Design Science research guidelines

The set of seven guidelines for design science research, as suggested by Hevner *et al.* (2004), was followed in conducting the study (cf. Table 2.3). These rules provide guidance as to the use and justification of design science research in IS. The last column in Table 2.3 describes how each specific guideline was implemented in the study.

Table 2.3. Design Science Research Guidelines (Hevner *et al.*, 2004, p. 83).

Guideline	Description	Implemented in this study
Guideline 1: Design as an artefact	Design science research must produce a viable artefact in the form of a construct, a model, a method, or an instantiation.	This design science research study produced a *methodology* as an artefact. The artefact was named TVET-MIS-EVAL methodology.
Guideline 2: Problem relevance	The objective of design science research is to develop technology-based solutions to important and relevant business problems.	The objective of the study was to design, develop and build a methodology for the evaluation of a MIS at a public TVET College in South Africa. No evidence of a relevant methodology could be found in the literature.
Guideline 3: Design evaluation	The utility, quality and efficacy of a design artefact must be rigorously demonstrated via well-executed evaluation methods.	The designed, developed and constructed artefact was iteratively demonstrated and evaluated on a selection of three public TVET Colleges which served as case studies.
Guideline 4: Research contributions	Effective design science research must provide clear and verifiable contributions in the areas of the design artefact, design foundations and/or design methodologies.	The study contributed to the world of the practitioner, by producing an applicable artefact, as well as to the academic literature domain. All activities in the design, development and building of the artefact were based on sound research practices. An article based on the study was published in the South African Journal of Information Management. An additional contribution of the study was the innovative evidence-based sample selection method by which the cases were selected.
Guideline 5: Research rigour	Design science research relies upon the application of rigorous methods in both the construction and evaluation of the design artefact.	The construction and evaluation of the artefact was informed by the design science research process model suggested by Peffers *et al.* (2006).

Guideline	Description	Implemented in this study
Guideline 6: Design as a search process	The search for an effective artefact requires utilising available means to reach desired ends while satisfying laws in the problem environment.	The artefact was designed, developed and built by the interaction of the design cycles proposed by Drechsler and Hevner (2016). It utilised extant literature (rigour cycle) and the problem environment (relevance cycle) to complete the design cycle. Extensive literature searches were conducted to inform the design and development of the artefact.
Guideline 7: Communication of research	Design-science research must be presented effectively, both to technology-oriented as well as management-oriented audiences.	The results of the study have been recorded in the thesis. Copies of the thesis will be distributed to the participating colleges. A journal article based on Chapter 7 was published in the South African Journal of Information Management (SAJIM) on 22 March 2017 and can be viewed at http://www.sajim.co.za/ index.php/SAJIM/article/view/751. On 26 September 2017, the complete article was viewed 971 times.

The following section provides information regarding the process model of the study.

2.4.4. Design Science Research Process (DSRP) model

The study was conducted in the design science research (DSR) paradigm and the process of the study was informed by the activities, described by Peffers *et al.* (2006), in the design science research process (DSRP) model to address the research problem which was delineated into research questions, as stated in section 1.2.3, and to develop the required artefact. The artefact produced in this study was named the TVET-MIS-EVAL methodology. The DSRP model adapted for this study is depicted in Figure 2.4 and presented in a customised and elaborated form in Figure 2.5.

It is interesting to note that the DSRP model was proposed by Peffers *et al.* (2006) in 2006. Two years later, in 2008, Peffers *et al.* (2008) incorporated the DSRP model in a methodology, called the design science research methodology (DSRM). The DSRM informed the framework of the artefact (TVET-MIS-EVAL methodology) developed in this study. A comprehensive description of the DSRM in terms of principles, practices, guidelines and procedures, is provided in Chapter 3, section 3.4.3.

As illustrated in Figure 2.4, the research study was initiated by a problem identified in the public TVET College business environment. The first of six activities in the nominal sequence of the DSRP model activities defines and motivates the research problem. The second activity involves defining the objectives of a solution. The design and development of the initial artefact, based on rigorous literature studies, constitute the third DSRP model activity. The fourth and fifth activities, namely *demonstration* and *evaluation*, assisted in the evaluation and refinement of the developed TVET-MIS-EVAL methodology (artefact). These two activities have been applied, iteratively, to the selected sample of public TVET Colleges and contributed to the iterative process nature of design-and-evaluate of design science research. The final activity in the DSRP model, *communication,* is the activity in which the created new knowledge and developed artefact were communicated to the relevant academic and practitioner audiences.

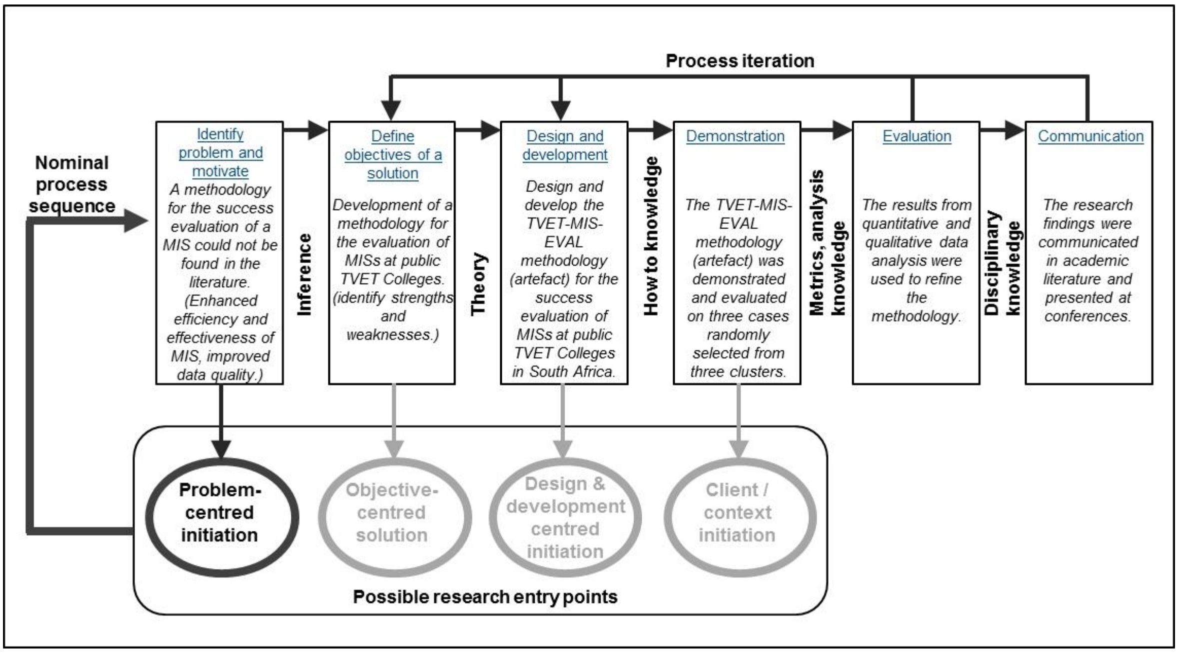


Figure 2.4. Illustration of the design science research process model adapted for this study (Peffers *et al.*, 2006, p. 93).

2.5. Process model of the study adapted from the DSRP model suggested by Peffers et al. (2006)

Figure 2.5 provides an illustration of the research process adopted for the study, which was informed by the DSRP model (Peffers *et al.*, 2006). The relationship between the DSRP model activities, phases of the study and the chapters of the thesis are indicated. The shaded part in Figure 2.5 situates this chapter within the process.

	INPUT →	PROCESS →	OUTPUT
PHASE 1	Literature: Theory, literature, reports, documents, expert discussion and interviews with stakeholders.	Literature review. Introduction to the research problem: *Identify problem and motivation of relevance.*	**Chapter 1:** Introduction to the research study, problem statement and motivation of relevance.
PHASE 2	Information in **Chapter 1.** Literature: theories, models, methods.	Design and develop the research methodology. Literature review: philosophies, paradigms, strategies.	**Chapter 2:** Research design and methodology on how the research problem was addressed.
PHASE 3	**Chapter 1 and 2**. Theory, literature, reports, documents, expert discussion and interviews with stakeholders on: • Methodology development; • IS success evaluation; • MIS at public TVET colleges.	Literature review: the literature studies, document analysis and inferences initialise and address the design science research process (DSRP) model activity: *Define objectives of a solution.*	Production of: • **Chapter 3:** Components of a methodology – output: framework for artefact. • **Chapter 4:** IS success evaluation models – output: model for artefact. • **Chapter 5:** MIS at public TVET colleges: context.
PHASE 4	Information in **Chapters 1-5.**	*Design and development* (Third activity in DSRP) of the initial methodology (artefact) for the evaluation of MIS at public TVET colleges.	**Chapter 6:** Developed TVET-MIS-EVAL methodology including procedures, methods, guidelines, data collection instruments, etc.
PHASE 5	• Theory on Web Maturity Models (WMM) → • Dataset on characteristics of colleges' websites → • Clusters of colleges →	• Design questionnaire based on WMM and evaluate public TVET colleges' websites → • Cluster analysis → • Random selection of one college per cluster →	• Dataset on website characteristics of public TVET colleges • Three clusters of public TVET colleges • Sample of three colleges **Chapter 7**
PHASE 6	Developed TVET-MIS-EVAL methodology – **Chapter 6.** Selected cases – **Chapter 7.**	DSRP activities: *Demonstrate, Evaluate, Communicate.* Also referred to as *design-demonstrate-evaluate* and *build-and-evaluate* iterations Demonstration and evaluation - College 1 Demonstration and evaluation - College 2 Demonstration and evaluation - College 3 Optimized evaluation methodology (artefact)	**Chapter 8:** • Findings from demonstration and evaluation on College 1 • Findings from demonstration and evaluation on College 2 • Findings from demonstration and evaluation on College 3 • Refinements to the TVET-MIS-EVAL methodology (artefact)
PHASE 7	**Chapter 1-8**	Conclude, synthesise, reflect, write and collate (DSRP activity: *Communicate*).	**Chapter 9:** Conclusion

Figure 2.5. Research process of the study delineated by phases, inputs, activities and outputs and linked to the design science research process (DSRP) model (Peffers *et al.*, 2006, p. 93).

The following sections explicate the phases in the research process of the study by elaborating on methods and procedures utilised within each phase of the process.

2.5.1. Phase 1: Problem identification and motivation as to relevance thereof

Based on the researcher's experience and knowledge of the public TVET College sector in South Africa as well as the government's priority to improve the public TVET Colleges to become institutions of choice for the youth, especially the unemployed youth, and thereby also address the lack of intermediate and artisanal skills in the country, the main research question was identified. The Department of Higher Education and Training (DHET) requires reliable data from public TVET Colleges to inform their planning and decision-making. The main research question focused on management information systems (MISs) deployed at public TVET Colleges. The need for an artefact (methodology) for the evaluation of MISs at public TVET Colleges was identified. No evidence of a methodology to evaluate MIS at public TVET Colleges in South Africa could be found in the literature.

By evaluating the MISs adopted by public TVET Colleges, shortcomings and weaknesses in the MISs can be identified and improved upon and these enhancements could lead to better management decision-making at college level and thus enrich reporting to the Department of Higher Education and Training on monitoring of nationally set targets. The main research question as stated in Chapter 1, section 1.2.3 is: *What are the components that constitute a methodology for the evaluation of a MIS at a public TVET College in South Africa?*

2.5.2. Phase 2: Description of the research design and methodology

This phase represents the information presented in this chapter. Design science, supported by pragmatism, was identified as a suitable philosophical paradigm for the study. The information systems research framework proposed by Hevner *et al.* (2004) informed the theoretical framework of the study. The process model utilised to conduct the study, which was to design, develop, build and evaluate the artefact, was informed by the DSRP model suggested by Peffers *et al.* (2006).

The framework of the artefact itself was informed by the design science research methodology (DSRM) proposed by Peffers *et al.* (2008), which will be explicated in Chapter 3, section 3.5. The procedures component (Phase C: Procedures) of the artefact was based on the SA-FETMIS success model proposed by Visser *et al.* (2012; 2013), which is explained in Chapter 4, section 4.8. The toolkit (Phase D: Toolkit) as part of the artefact utilised a mixed-methods approach and used quantitative and qualitative methods for data collection and analysis. The development of these instruments is discussed in Chapter 4, section 4.10. Figure 2.6 presents the conceptualisation of the study.

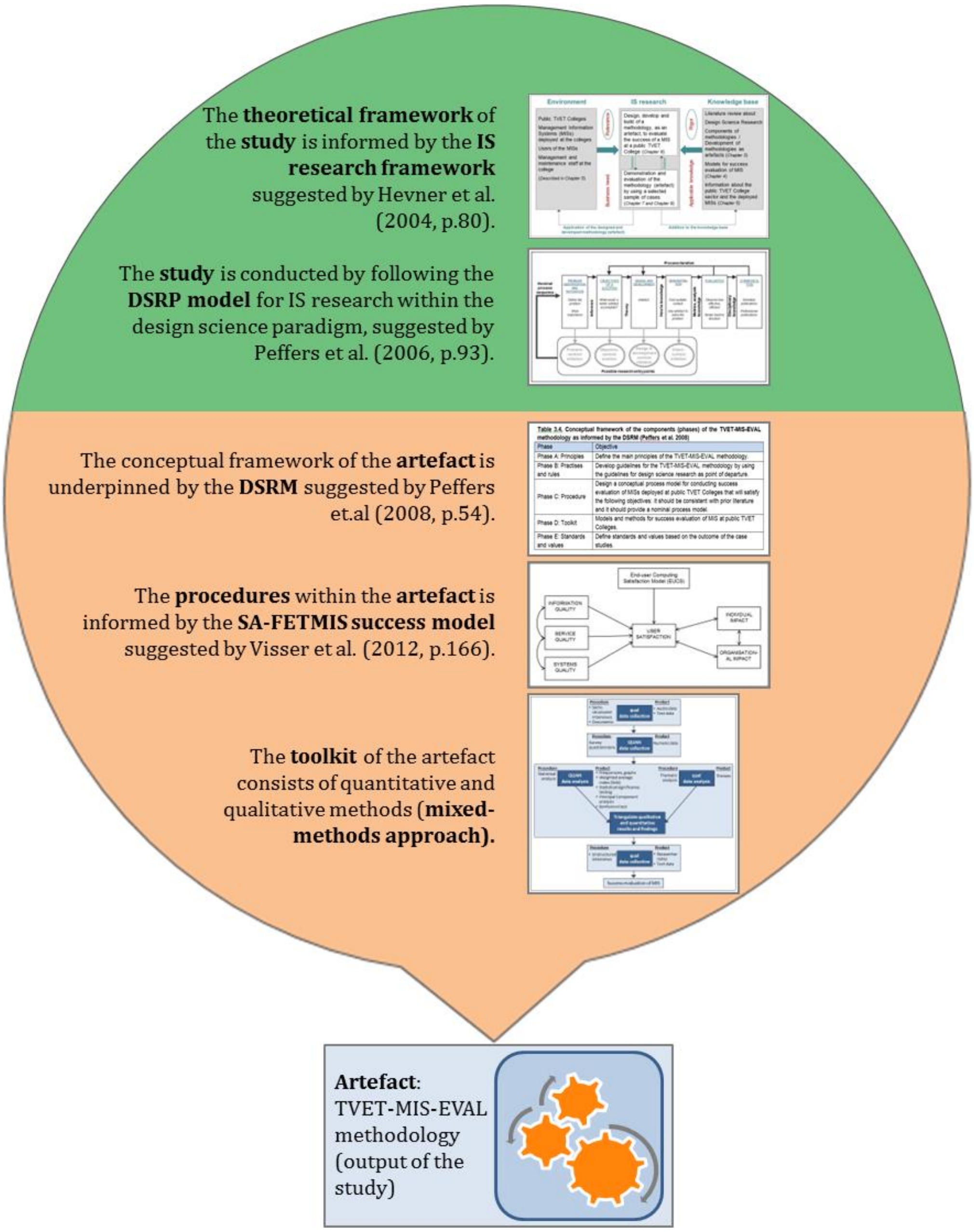


Figure 2.6. Conceptualisation of the study.

2.5.3. Phase 3: Define objectives of a solution

The activity of *defining objectives of a solution* is the second activity in the DSRP model suggested by Peffers *et al.* (2006). Activities in this phase relate to the search for a solution for the identified problem.

During Phase 3, keeping the main and sub-research questions in mind, information and data were gathered through a variety of channels. The main channel was the review of extant literature and documentation about the three knowledge domains of the study (deducted from the main research question) namely: methodology development (cf. Chapter 3); models for IS success evaluation (cf. Chapter 4) and the public TVET College sector in South Africa (cf. Chapter 5). Many internet and academic literature database searches and informal discussions with stakeholders and TVET sector experts were conducted to gather information about components of a methodology as an artefact for the evaluation of MISs deployed at public TVET Colleges.

The outputs generated during this phase as discussed in Chapters 3, 4 and 5, provide background for understanding the research problem; motivate the relevance of the problem and provide building blocks towards the design and development of a solution (artefact).

2.5.4. Phase 4: Development of TVET-MIS-EVAL methodology (artefact)

This phase addresses the third activity in the DSRP model namely the *design and development* of the artefact (Peffers *et al.*, 2006).

The literature studies conducted in Phase 3 of the research process of the study on the three knowledge domains, as reported on in Chapters 3, 4 and 5, informed the design, development and construction of the TVET-MIS-EVAL methodology (artefact) for the evaluation of MISs at public TVET Colleges in South Africa.

The output of Chapter 3 was a conceptual framework for a methodology as an artefact. This conceptual framework has been adapted from the design science research methodology (DSRM), suggested by Peffers *et al.* (2008). Chapter 4 produced a process model for inclusion in the artefact, which has been informed by the SA-FETMIS success model suggested by Visser *et al.* (2012; 2013). Chapter 5 informed the components, which comprise of the principles, guidelines, practices and rules (Phases A and B) of the artefact. The developed TVET-MIS-EVAL methodology (artefact) consists of five components embedded in a pragmatic philosophical paradigm, as described in Chapter 6, namely: Phase A: Principles; Phase B: Guidelines, practices and rules; Phase C: Procedures; Phase D: Toolkit; and Phase E: Standards and values.

2.5.5. Phase 5: Sample selection

This phase is part of the fourth DSRP model activity, namely *demonstration*, and the fifth DSRP model activity, namely *evaluation*, of the artefact (Peffers *et al.*, 2006).

The purpose of this phase was to select a sample of public TVET Colleges where the designed, developed and constructed artefact could be demonstrated and evaluated towards suggestions for refinements to the artefact. It was decided to apply the artefact on a selection of colleges with different levels of management information systems (MIS) maturity to enhance the rigour of the artefact. Therefore, the population of colleges had to be grouped according to the maturity level of the MIS deployed at the college.

An innovative evidence-based method was utilised to cluster the population of 50 public TVET Colleges into groups with similar levels of information systems maturity. The method made use of web maturity models theory and is comprehensively explained in Chapter 7. Three clusters emerged from the process and were named Cluster 1, Cluster 2 and Cluster 3. One college was randomly selected from each cluster. The selected colleges were named College 1 from Cluster 1, College 2 from Cluster 2 and College 3 from Cluster 3 to protect their anonymity and for confidentiality reasons. The three selected colleges served as cases in which the TVET-MIS-EVAL methodology (artefact) was iteratively demonstrated, evaluated and refined. Chapter 7, in which the sample selection and clustering processes were described, is the output of this phase.

The following sections provide theory regarding sampling strategies in research for the purpose of elaborating on theory considered in this phase (Phase 5) of the research process.

2.5.5.1. Sampling frame

A sampling frame is a list or collection of the whole population of people, events or documents that could be included in a survey (Olivier, 2004; Oates, 2006). In this study the sampling frames constituted of, firstly, all public TVET Colleges in South Africa and, secondly, all staff members at the selected public TVET Colleges who were users of the MIS deployed at the college.

A sampling technique refers to the way in which one sets about selecting a sample from the sampling frame. As depicted in Table 2.4, two main categories of sampling techniques exist: probability and non-probability sampling techniques (Oates, 2006). In probability sampling, there is a high probability that the sample of respondents chosen is representative of the overall population (findings are generalisable), while with non-probability sampling researchers do not know whether the sample is representative or not.

Table 2.4. Sampling techniques (Oates, 2006).

Probability	**Non-probability**
Random sampling	Purposive sampling
Systematic sampling	Snowball sampling
Stratified sampling	Self-selection sampling
Cluster sampling	Convenience sampling

In the application, demonstration and evaluation of the artefact, the first sampling frame from which a selection had to be made was the population of public TVET Colleges. The sample of public TVET Colleges was selected by using an innovative cluster-random sample selection technique, briefly explained above and extensively explicated in Chapter 7.

The application of the artefact required a second sampling frame, which consisted of the population of all users of the MIS at the selected public TVET Colleges. No sample selection was done on these populations since the plan was to survey the full population of MIS users during the application and evaluation of the artefact at each college. A total of 69 respondents across the three cases completed the administered questionnaire and consisted of 8, 14 and 47 respondents from College 1, College 2 and College 3, respectively.

2.5.5.2. Representativeness (Generalisability)

The public TVET College sector is characterised by the uniqueness of its institutions. The nature of programmes offered, the skills need of the immediate community and the physical location of the institutions, along with the type of industry associated with that geographical area, are just some of the factors that emphasise this uniqueness (cf. section 8.3). Despite their uniqueness, colleges are governed similarly by the DHET. Data submission requirements are the same for all colleges, national programme assessments are standardised and three types of information management systems are utilised in their business practices (cf. section 5.4.1).

As explained in Chapter 7, in which the case selection method is illuminated, the study endeavoured to account for the uniqueness in terms of the MIS deployed at the colleges, in its sample selection. The selection of a college from each cluster allowed the researcher to demonstrate, evaluate and refine the TVET-MIS-EVAL methodology (artefact) on colleges with different MIS maturity levels and by doing so, enhance the generalisability of the application of the TVET-MIS-EVAL methodology (artefact).

2.5.6. Phase 6: Design-Demonstrate-Evaluate

Based on the fourth (*demonstration* of the artefact) and fifth (*evaluation* of the artefact) DSRP model activities (Peffers *et al.*, 2006), the developed TVET-MIS-EVAL methodology was iteratively demonstrated, evaluated and refined by applying it on the three selected cases (public TVET Colleges). Findings from demonstrating and evaluating the TVET-MIS-EVAL methodology contributed to the refinement of the artefact.

The following sections discuss different aspects related to the application, demonstration and evaluation of the artefact. Section 2.5.6.1 presents evaluation methods utilised in design science research; section 2.5.6.2 elaborates on case study strategies; section 2.5.6.3 presents information on how access to the selected cases was obtained; section 2.5.6.4 provides more information about survey strategies and section 2.5.6.7 presents theory on triangulation.

2.5.6.1. Evaluation methods in design science research

In design science research the developed artefact can be evaluated by using the methods presented in Table 2.5 (Hevner *et al.*, 2004). The TVET-MIS-EVAL methodology (artefact) was evaluated by using the experimental evaluation method, the artefact was thus studied in a controlled environment, which included the selected sample of public TVET Colleges (controlled experiment), for its *applicability*.

Table 2.5. Design evaluation methods (Hevner *et al.*, 2004, p. 86).

Method	Description
1. Observational	Case study: Study artefact in depth in business environment.
	Field study: Monitor use of artefact in multiple projects.
2. Analytical	Static analysis: Examine structure of artefact for static qualities (e.g. complexity).
	Architecture analysis: Study fit of artefact into technical IS architecture.
	Optimisation: Demonstrate inherent optimal properties of artefact or provide optimality bounds on artefact behaviour.
	Dynamic analysis: Study artefact in use for dynamic qualities (e.g. performance).
3. Experimental	Controlled experiment: Study artefact in controlled environment for qualities (e.g. usability, applicability).
	Simulation – Execute artefact with artificial data.
4. Testing	Functional (Black box) testing: Execute artefact interfaces to discover failures and identify defects.
	Structural (White box) Testing: Perform coverage testing of some metric (e.g. execution paths) in the artefact implementation.
5. Descriptive	Informed argument: Use information from the knowledge base (e.g. relevant research) to build a convincing argument for the artefact's utility.
	Scenarios: Construct detailed scenarios around the artefact to demonstrate its utility.

The application of two of the components of the TVET-MIS-EVAL methodology, namely, Phase C: Procedures and Phase D: Toolkit, made use of a mixed-methods approach. Qualitative and quantitative data were collected in these phases by using semi-structured interview schedules and survey questionnaires, respectively. Quantitative and qualitative data analyses were performed as part of the application of the artefact.

2.5.6.2. Case study strategy

Case study research is an approach which is used extensively in a wide variety of disciplines, particularly in the social sciences. It generates an in-depth, multi-faceted understanding of a complex issue in its real-life context (Crowe *et al.*, 2011). According to Yin (2003) and Lazar as well as Feng and Hochheiser (2010), there are three types of case study namely: intrinsic or instrumental; single cases or multiple cases; and embedded or holistic case studies. The authors explain these types as follows:

- *Intrinsic or instrumental case studies***:** Intrinsic studies describe cases that are of inherent interest; however, the results of these studies apply only to the relevant case. Instrumental case studies, on the other hand, ask questions in the hope of generating insights that go beyond the case at hand.
- *Single or multiple case studies*: The goals of the study may play a role in determining whether one should use a single case or multiple cases. Multiple cases are most useful when one is interested in generalising the results. However, as some case studies may describe a unique case that cannot easily be compared to others, multiple-case studies are difficult, if not impossible. Olivier (2004) infers that multiple-case studies facilitate comparisons between cases which will contribute to the conclusions. Olivier (2004) further identifies different types of single case study: critical case, extreme case, unique case and revelatory case.
- *Embedded or holistic case studies*: Yin (2003) and Laser *et al.* (2010) explain that the inclusion of multiple units of analysis within a single case is referred to as an embedded case study, in contrast to holistic studies that address only one unit of analysis in each case.

Lazar *et al.* (2010, p. 150) further note that case studies can have any one, or a combination, of the following four goals:

- *Exploration* – understanding novel problems or situations, often with the hope of informing new designs.
- *Explanation* – developing models that can be used to understand a context of technology use.
- *Description* – documenting a system, a context of technology use, or the process that led to a proposed design.
- *Demonstration* – showing how a new tool was used successfully.

In this study, *multiple cases* were selected (cf. Chapter 7) with the aim of *demonstrating* the applicability of the TVET-MIS-EVAL methodology (artefact) and, simultaneously, evaluating the artefact by sequentially applying it to the three selected cases, towards the refinement of the artefact.

The cases were *instrumental* because they were utilised in a process of refining the artefact for generalisation of its applicability across the public TVET College sector. Each case study can be classified as *holistic*, because only one unit of analysis was studied namely the MIS deployed at the college. The context of each case study consisted of influential elements of the DHET, the TVET College and college staff members and the MIS deployed at the college, as depicted in Figure 2.7.

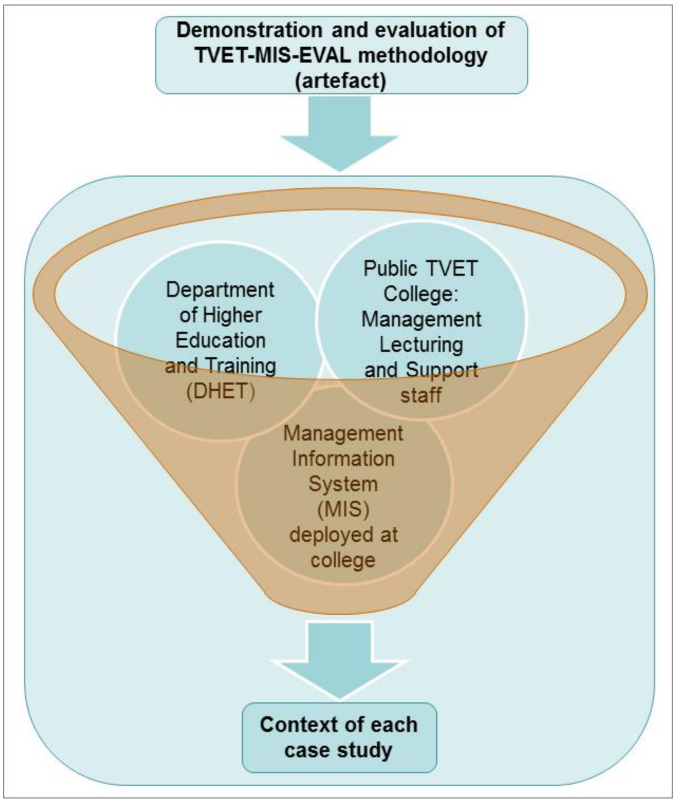


Figure 2.7. Graphical representation of the context of each case study.

The next section provides information about access to the three selected public TVET Colleges.

2.5.6.3. Gaining access

It can sometimes be very difficult and/or expensive to obtain access to confidential sources of information. In the application of the components, *Phase C: Procedures* and *Phase D: Toolkit* of the TVET-MIS-EVAL methodology, most of the sources of information about the cases studied were already in the public domain, thus gaining access to these resources was not difficult. Most of the literature sources specific to the operation and strategic planning related to the MISs deployed at the selected public TVET Colleges were given to the researcher by the contact person(s) at the colleges, or communicated through semi-structured interviews.

Contact with the selected colleges was initiated by sending formal letters, attached to emails, addressed to the principal/CEO of each college requesting permission to conduct the study and for access to the college (cf. Appendix B).

After permission was granted, a contact person at each college was appointed through whom all communication to, and from, the college was routed. The initially selected college in Cluster 1 declined the invitation to participate in the study and it had to be replaced with a randomly selected college in the same cluster. The reason provided for the refusal was that the college was already participating in another research study. The dates associated with this process are provided in Table 2.6.

The CEO and staff of the colleges were efficient and helpful in all the relevant facets of the application of the artefact. The contact person at each college facilitated the administration of the survey. The survey questionnaire was completed by all users of the MIS deployed at each selected public TVET college who were available at the day of the survey.

Table 2.6. Dates in the process of gaining access to selected colleges.

College	Date of email requesting access:	Apart from many telephone conversations with colleges, follow-up email communication occurred on:	Date of visit (survey and interviews):
College 1 (Refused)	3 August 2015	The college declined the invitation to participate in the study on 3 September 2015 because it was already participating in another intervention study.	
College 1 (Replacement)	8 October 2015	14, 16, 20, 21 October 2015	23 October 2015
College 2	3 August 2015	6, 12, 17 August 2015	24 August 2015
College 3	3 August 2015	12, 13, 16, 26 August and 1, 2 September 2015	15 September 2015

The next section elaborates on survey strategies.

2.5.6.4. Survey strategy

Surveys are one of the most commonly used research strategies across all fields of research. They are frequently used to describe populations, to explain behaviours and to explore unknown topics (Babbie, 1990). A survey research strategy provides a quantitative or numeric description of trends, attitudes, or opinions of a population by studying a sample of that population (Creswell, 2014). It includes cross-sectional and longitudinal studies which use questionnaires or structured interviews for data collection, with the intention of generalising from a sample to a population (Fowler, 2009).

Lazar *et al.* (2010) note that the strength of the survey strategy is its ability to gather a large number of responses quickly from a population of users – findings can then be generalised to the larger population. Surveys also allow one to make statistically accurate estimates for a population.

The difference between surveys and questionnaires can be explained as follows: a survey is the complete methodological approach (strategy), including sampling, the questionnaire, reminders and incentives, while a questionnaire is the list of structured questions (Lazar, Feng & Hochheiser, 2010). Therefore, a questionnaire is only one element of a survey strategy.

While paper questionnaires, as part of a survey strategy, have long been used to gather information, online survey questionnaires are now also being utilised. There are two types of online survey questionnaires, namely web-based and e-mail questionnaires. Unlike other methods of data collection, most online surveys are linked to an online database and have the capability to offer immediate results. A call centre company can also be used as part of a survey strategy to administer a survey questionnaire when contact details of participants are available. Call centre assistance can be very useful to increase the response rate of a survey (Kaplowitz *et al.*, 2004; Manfreda *et al.*, 2008).

A survey strategy was adopted as part of *Phase C: Procedure* of the TVET-MIS-EVAL methodology, hence a sample of colleges was selected in which a questionnaire was administered to all users of the MIS deployed at each selected college.

2.5.6.5. Triangulation

According to Oates (2006), the use of more than one research strategy is called *strategy triangulation.* Two of the components of the artefact (TVET-MIS-EVAL methodology), namely *Phase C: Procedures* and *Phase D: Toolkit*, made use of a survey strategy administered on a case. The study, furthermore, utilised more than one data generation method to corroborate findings (cf. section 2.6) and, hence, enhanced their validity. This is called *method triangulation*. Oates (2006) explains that many types of triangulation are possible and notes the following types:

- *Method* triangulation – the study uses two or more data generation methods.
- *Strategy* triangulation – the study uses two or more research strategies.
- *Time* triangulation – the study takes place at two or more different points in time.
- *Space* triangulation – the study takes place in two or more different countries, or cultures, to overcome the narrow-mindedness of a study based in just one country or culture.
- *Investigator* triangulation – the study is carried out by two or more researchers who then compare their accounts.
- *Theoretical* triangulation – the study draws on two or more theories rather than one theoretical perspective only.

The following section provides information about the final DSRP model activity namely, *communication,* which underpins the final phase of the research process model of the study.

2.5.7. Phase 7: Communication

During this phase the findings of the study were synthesised and concluded. The contributions of the study, to the academic and practitioner domains were documented and communicated. The output of this phase is documented in Chapter 9.

The next section discusses data collection methods utilised within the different phases of the research process of the study.

2.6. Data collection methods

According to Oates (2006), a data generation method is the means by which a researcher produces empirical data or evidence. Data can either be quantitative (e.g. numeric data) or qualitative (e.g. words, images, sounds).

Data collection techniques allow us to systematically collect information about our objects of study (computer systems, people, objects, phenomena) and about the settings in which they occur. In primary data collection, data is collected by using methods such as interviews and questionnaires. The key point here is that the data collected is unique to the current research study and, until published, no one else has access to them. There are many methods of collecting data and the main methods include questionnaires, individual interviews, focus group interviews, observation, documents, critical incidents and portfolios (Oates, 2006). The data collection methods utilised in this study, are documents, interviews and questionnaires as described in the following sections.

2.6.1. Documents

Document analysis describes the act of reviewing existing academic literature or documentation of a specific topic under investigation in order to extract pieces of information that are relevant to the investigation (Oates, 2006).

Extensive literature reviews and document analyses were conducted, which included the consultation of primary, secondary and tertiary sources to investigate and address the main and sub-research questions of the study (cf. section 1.2.3).

A detailed description of the systematic approach to the literature review for the study is provided in Chapter 1, section 1.3.1. Figure 1.2 presents the framework for the systematic literature review, linked to the research questions of the study. The artefact (TVET-MIS-EVAL methodology) was designed, developed and constructed based on theories, methods and models, which were sourced from extant academic literature. Chapter 3 presents a literature review and document analysis on components of methodologies, Chapter 4 illuminates literature about MIS success evaluation models, constructs and effectiveness measures for measuring information systems success. Chapter 4, furthermore, provides detail about how the sets of questions (questionnaire design), as part of the TVET-MIS-EVAL methodology, were informed by existing literature. Chapter 5 consists of information about the public TVET College sector, which is the context of the proposed TVET-MIS-EVAL methodology. Thus, academic literature related to the main and sub-research questions, literature reviews and document analysis informed the design of the TVET-MIS-EVAL methodology (cf. Chapter 6 for the developed TVET-MIS-EVAL methodology).

In addition, institutional documents pertaining to the implementation, maintenance and management of the MISs deployed at the public TVET College, that is, business plans, strategies for the implementation of the ICT, user manuals and user requirement statements were collected and studied in order to obtain a clear understanding of the MIS deployed at the three selected public TVET Colleges and the data and information requirements set by DHET.

2.6.2. Interviews

Lazar *et al.* (2010) explain that one should ensure that all relevant groups are represented when planning and conducting interviews. According to the authors, a stakeholder is anyone affected by the use of a system. In this study, meetings were arranged and held with the MIS manager and the IT manager at each selected public TVET College to solicit information pertaining to the MISs and its stakeholders. A semi-structured interview was also conducted with the data manager of TVET Colleges at the Department of Higher Education and Training (DHET), to gain insight into the DHET's plans and strategies relating to the public TVET College sector. The final group of interviewees included the MIS users. Follow-up telephone calls were made to a selected sample of MIS users in order to gain more insight and confirmation regarding emerging trends in the data analysis of the quantitative data which were collected through the administered questionnaire. Interview schedules were developed as part of *Phase C: Procedures* and *Phase D: Toolkit* of the TVET-MIS-EVAL methodology (cf. Appendix D). The interviews conducted with the MIS and IT managers at the DHET and selected TVET Colleges were audiotaped on digital recorders and the other interviews were recorded in the researcher's field notes.

2.6.3. Questionnaire

According to Lazar *et al*. (2010), a survey questionnaire is a well-defined and well-written set of questions to which an individual is asked to respond. Questionnaires are a popular means of collecting data, but are difficult to design and often require many rewrites before an acceptable version is produced. Typically, questionnaires are self-administered by individuals, with no researcher present; because of this, the data collected is not as in-depth as that collected with other strategies, such as ethnographies.

The following types of question can be included in a questionnaire: closed, open-ended and attitudinal questions (Oates, 2006). Mouton (2001, p. 103) lists the most common errors in questionnaire construction as follows:

- No piloting or pre-testing is done.
- Ambiguous or vague items – words that are undefined, too vague, or that assume too much about the respondents.
- Double-barrelled questions – these are questions that combine two or more questions in one.
- Item order effect – research has shown that the order or sequence of questions may affect response accuracy and response rates.
- Fictitious constructs – sometimes constructs, or attitudes, are measured that do not exist, for example asking people about matters of which they have no knowledge.
- Leading questions – questions where the respondent is being led or influenced to give a certain response through the wording of the questions.
- Negatively phrased questions or double negatives (especially when asking people to agree or disagree with such a question).
- Poor or confusing layout of the questionnaire can lead to non-response or other errors.

- Instruments that are too long can have a negative impact on the quality of the responses.
- Sensitive, or threatening, questions may lead to non-responses or refusal to participate.
- Avoid mono-operational bias, which is, measuring constructs using only a single item or question – instead, construct a scale or index where possible.

The questionnaire which was specially designed and developed for this study, as part of *Phase D: Toolkit of the TVET-MIS-EVAL methodology*, took these warnings into account. The questionnaire was developed from empirically tested instruments presented in six academic studies. The instrument was administered to all users of the MIS at the three selected public TVET Colleges. The administration of the questionnaire during the demonstration and evaluation of the artefact can, furthermore, be considered as a pilot of the instrument since the aim was to suggest refinements or improvements to the developed artefact (TVET-MIS-EVAL methodology). A copy of the questionnaire can be viewed in Appendix E.

The questionnaire consists of four sections of questions: (Section 1) identification and consent, (Section 2) employment information, (Section 3) MIS evaluation and (Section 4) personal information. Development of the questionnaire, as part of the TVET-MIS-EVAL methodology, is discussed in Chapter 4, section 4.10.

The questions related to MIS success evaluation, within each evaluation construct, are in the form of *frequency-of-use Likert rating scale* questions, which required respondents to indicate their degree of satisfaction with specific aspects of the MIS on a scale of 1 to 5, where 1 equals *never or almost never*; 2 equals *some of the time*; 3 equals *about half of the time*; 4 equals *most of the time*; and 5 equals *always or almost always.* To be able to identify missing or no responses another option: 6 equals *not applicable/don’t know*, was added.

2.6.4. Validity and reliability

Validity and reliability of data collected via instruments are associated with quantitative research methods in post-positive philosophical paradigms and lead to meaningful interpretations of data (Creswell, 2014). Validity refers to the extent to which the data collection strategies and instruments measure what they purport to measure. If a concept, conclusion or measurement is well-founded and corresponds accurately to the real world, it has validity (OECD, 2010). Reliability relates to the consistency, or dependability, of data and evaluation judgements, with reference to the quality of the instruments, procedures and analyses used to collect and interpret data. The information is reliable when repeated observations using similar instruments under similar conditions produce similar results (OECD, 2010).

The survey questionnaire as part of *Phase D: Toolkit* of the TVET-MIS-EVAL methodology was specifically designed and developed using items from existing empirically tested instruments sourced from academic literature (cf. Chapter 4, section 4.10). The questions included in the questionnaire constitute a well-balanced sample of the domain intended to cover, as discussed in Chapter 4, section 4.10. Furthermore, the use of previously empirically tested questionnaires, as well as the assistance and opinions from experts in constructing the questionnaire, assisted in addressing content validity. Construct validity was established by correlating responses to questions in the questionnaire with other information gathered from the literature reviews and the semi-structured and unstructured interviews with key system users at the relevant institutions.

The questionnaire was administered to all MIS users at the selected public TVET Colleges, who were available during administration. The survey instrument was developed and refined to suit the required purposes through the following process:

- grounding in the literature on methodologies and success evaluation of MIS;

- case studies of research-oriented forms of methodologies and MIS success evaluation in the literature;
- following an iterative process of revision with comments and inputs from the study supervisors and experts in the field from DHET and public TVET Colleges.

The following section illuminates the data analysis methods utilised.

2.7. Data analysis methods

Creswell (2014) explains that quantitative data analysis uses mathematical approaches such as statistics to examine and interpret data, while qualitative data analysis looks for themes and categories within the words people use, or the images they create. In this study, both qualitative and quantitative data analysis methods were used in the demonstration and evaluation activities of the DSRP model to evaluate the TVET-MIS-EVAL methodology (artefact).

Different data analysis techniques were utilised in different phases of the research process of the study (cf. Figure 2.5). For instance, literature reviews, document analyses and theme identification (qualitative data analysis) were mainly conducted in Phase 3, which preceded, informed and culminated in the design and development of the proposed artefact. Document analysis is a form of qualitative research in which the researcher interprets documents to give meaning to the specific topic under investigation by incorporating the hermeneutic cycle. Analysing documents involves coding of content into themes similar to the procedures used for focus group or interview transcripts (Oates, 2006). The development of the artefact (TVET-MIS-EVAL methodology) was informed by the literature reviews, document analyses and stakeholder interviews, as is evident in Chapters 3 to 6.

The questions in the questionnaire (part of Phase C: Procedures and Phase D: Toolkit of the TVET-MIS-EVAL methodology) were designed to generate two types of data: factual data and opinions. All, except one, of the questions that produced factual data (19 questions) were closed questions where the respondents were required to choose from a range of predefined answers. Only one question was an open-ended question where the respondent had to state his/her position in the college. The questions that related to the respondents' opinions (66 questions) were about IS success evaluation and were in the form of *frequency-of-use Likert rating scale* questions (where 1 equals *never or almost never*, 2 equals *some of the time*, 3 equals *about half of the time*, 4 equals *most of the time*, and 5 equals always or *almost always*). Therefore, it was essential to use exploratory analysis (such as frequencies and descriptive analysis, including mean, mode, minimum, maximum, range and standard deviation) as well as inferential statistical analysis (Huck, 2008, p. 19).

With inferential statistics, the aim was to reach conclusions that extended beyond the immediate data alone. For instance, inferential statistics were used to infer from the sample data what the population might think or to judge whether the probability that an observed difference between groups was dependable or incidental in the study (Huck, 2008; Field, 2009). Thus, inferential statistics were used to draw inferences from the data towards more general conditions and descriptive statistics were used to simply describe what was going on in the data.

Statistical and inferential data analysis techniques were specifically utilised in Phase 6 of the research process of the study (on quantitative data), in which the developed artefact was demonstrated and evaluated as part of *Phase C: Procedures* and *Phase D: Toolkit* of the TVET-MIS-EVAL methodology (artefact). During the evaluation of the artefact in Phase 6, qualitative data were also collected by means of semi-structured interviews with staff members of the selected TVET Colleges, which were analysed by using theme identification. The results of the data analysis are presented in Chapter 8.

Table 2.7 provides a list of all statistical analysis techniques that were used in the study. The first column in the table provides the section in which each procedure has been defined and explained and the third column states the purpose of the technique for the study.

Table 2.7: Statistical analysis techniques used in this study.

Section	Statistical analysis technique	Purpose
2.7.1	Exploratory data analysis	All variables in the questionnaire were subjected to exploratory data analysis such as frequency tables and graphs.
2.7.2	Weighted average index (WAI)	WAI was only calculated for variables related to perceptions/opinions of the MIS success evaluation.
2.7.3	Principal component analysis (PCA), rotated factor patterns	This procedure was conducted to evaluate the unidimensionality of the underlying variables of constructs or indicators in the MIS evaluation model.
2.7.4	Cronbach's alpha (reliability of constructs)	This procedure was performed to establish the internal reliability of the underlying variables of constructs or indicators in the MIS evaluation model.
2.7.5	Statistically significant relationships	Pearson's correlation coefficient, Kendall's tau_b and Spearman's rho are tests for measuring the correlation between two variables. Kendall's tau_b correlation coefficients were calculated to establish the statistical significance of an association between two variables.
2.7.6	Shapiro-Wilk test for normality	Tests for normality compare the shape of the sample distribution to the shape of a normal curve. This statistical procedure was used to test if the dependent variable in the regression analysis satisfies the requirement for normality.
2.7.7	Linear regression analysis	Linear regression analyses were conducted to calculate the predictor value of the MIS success construct variables to predict the independent variable (*overall evaluation*).

The following sections briefly explain the different statistical procedures performed in this study:

2.7.1. Exploratory data analysis

Pietersen and Damianov (2001) explain that although research may be conducted in a familiar area, the collected data should still be viewed as something unknown that requires some exploration. No two samples, even when the same subject matter is concerned, will yield the same data. According to these authors, the two tools researchers generally start with when exploring non-metric variables are one-way frequency tables and graphs. Exploratory data analyses also include descriptive analysis, which include the mean, mode, minimum, maximum, range and standard deviation (Field, 2009).

2.7.2. Weighted average index (WAI)

Exploration of the data commenced with the calculation of an average or mean (WAI) for each question based on a *frequency-of-use Likert rating scale* response. This methodology was adapted from a study that was conducted by the HSRC (Kruss, Visser, Aphane & Haupt 2011, p. 34). An average for each question was calculated within each IS evaluation-construct as well as for the total population. This was done to facilitate the exploration of the importance of each variable against the other variables and overall.

The formula below was used in the calculation of the WAI (Kruss *et al.*, 2011, p. 35):

$$WAI = \frac{\sum_{i=1}^{5} F_i W_i}{N}$$

where F equals the frequency of a specific value (between 1 and 5) selected by the respondents, W equals the actual value selected, that is, the weight (value between 1 and 5) and N the number of responses.

2.7.3. Principal component analysis (PCA) and rotated factor patterns

Another series of procedures in the data analysis included principal component analysis (PCA) (Pearson, 1901). PCA is often used in the social sciences, but in the natural sciences it is more commonly known as factor analysis (Field, 2009). These analyses were done to assess the feasibility of reducing the large number of variables within each IS success evaluation construct, to components of variables that describe these constructs. Information about the development of first- and second-order factors and their underlying variables is presented in Chapter 8.

The principal component factor analysis extraction method was used to measure the IS success evaluation variables. The Kaiser criterion, developed in 1960, was used to select the number of underlying factors or principal components explaining the data (Field, 2009). In this study, this number was decided on by omitting components with corresponding eigenvalues of less than one. This is the rule of thumb when conducting PCA using a correlation matrix (Field, 2009). Since PCA uses the prior communalities of one, it tends to inflate factor loadings, which makes identification of patterns/themes relatively easier.

2.7.4. Cronbach's alpha (reliability of constructs)

According to Field (2009), Cronbach's alpha (Cronbach, 1951) is a measure of reliability based on the split-half reliability test. In 1951, the statistician Cronbach designed a measure that is loosely equivalent to splitting data into two in every possible way and computing the correlation coefficient for each split (Field, 2009). The average of these values is equivalent to Cronbach's alpha, which is the most common measure of scale reliability. Hence, Cronbach's α is:

$$\alpha = \frac{N^2\overline{Cov}}{\sum s^2{}_{item} + \sum Cov_{item}} \quad \text{(Field, 2009, p. 674).}$$

Field (2009) further notes that a value of 0.7 to 0.8 is an acceptable value for Cronbach's α. This procedure was used to test whether the questions in each IS success evaluation construct did in fact measure the same thing, that is, whether or not they were unidimensional.

2.7.5. Bivariate correlation – statistically significant correlation

One can use three different procedures to calculate correlation coefficients: Pearson's correlation, Spearman's rho and Kendall's tau (Field, 2009).

Pearson's correlation (Pearson, 1900) is used when it is assumed that the sampling distribution is normal, both variables must be normally distributed – one exception to the rule is that one of the variables can be a categorical variable provided there are only two categories. Spearman's rho (Spearman, 1904) is a non-parametric statistic and is utilised when the data have violated parametric assumptions such as non-normally distributed data. Kendall's tau (τ)

(Kendall, 1938) is a non-parametric correlation and should be utilised instead of Spearman's coefficient when one has a small data set with a large number of tied ranks. This means that if you rank all of the scores, and many scores have the same rank, then Kendall's tau should be used. Although Spearman's statistic is the more popular of the two coefficients, there is much to suggest that Kendall's statistic is actually a better estimate of the correlation in the population. More accurate generalisations can be drawn from Kendall's statistic than from Spearman's (Field, 2009, p. 175).

2.7.6. Shapiro-Wilk test for normality

Tests for normality compare the shape of the sample distribution to the shape of a normal curve. The assumption is, if the sample has a normal shape, the population from which it came is also normally distributed and therefore one can assume normality. If the test result is significant then it means that the sample distribution is not shaped like a normal curve and the assumption of normality is rejected. There are two commonly used tests, Shapiro Wilks (Shapiro & Wilk, 1965) and Kolmogorov-Smirnov (Chakravarti, Laha & Roy, 1967). For tests on samples of $n = 3$ to 2 000 Shapiro Wilks is utilised and for samples of $n > 2\ 000$ Kolmogorov-Smirnovis is used (Department of Geography, UNT, 2010).

2.7.7. Linear regression analysis

There are many ways to assess the relative contribution of each independent variable on the criterion, or dependent variable. One can add all independent or predictor variables simultaneously in a model, called the *enter* method, or one can use a statistical method. In statistical methods, the order in which the predictor or independent variables are entered into the model is based on the strength of their correlation with the dependent variable. Some of the versions of this method include *Forward*, *Backward* and *Stepwise* selections (Brace, Kemp & Snelgar, 2012).

In *Forward* selection, the independent variables are included into the model one at a time in an order determined by the strength of their correlation with the dependent variable. The effect of adding each independent variable is assessed as it is entered. Variables that do not significantly add to the success of the model are excluded.

All the independent variables are entered into the model in the *Backward* selection method. The weakest independent variable is then removed and the regression re-calculated. If this does not significantly weaken the model then the independent variable is deleted – otherwise it is re-entered. This procedure is repeated until only significant independent variables remain in the model.

The *Stepwise* method is regarded as the most sophisticated method. The independent variables are entered sequentially and their value assessed. If adding the variable contributes to the model it is retained, but all other variables in the model are then re-tested to see if they still contribute significantly to the success of the model – if not, they are removed. This method ensures that the smallest possible set of independent variables are included in the model – thus the most parsimonious model is produced (Brace, Kemp & Snelgar, 2012).

2.7.8. Data analysis tools

Three main software application tools facilitated the data analysis for this study: MS Access 2010, IBM SPSS version 24 and MS Excel 2010. MS Access is a database management tool that forms part of the Microsoft Office Professional package. MS Excel is a mathematical spreadsheet-type application that is also one of the software applications included in the Microsoft Office package. IBM SPSS is a Statistical Software Package for Social Sciences.

During the application of *Phase C: Procedures* and *Phase D: Toolkit* of the artefact, data were collected through the administration of a survey questionnaire (cf. Appendix E). The data were captured on a form which was designed and developed in MS Access 2010. MS Access was also used for data cleaning and the initial querying of the data sets. Exploratory and inferential statistical procedures were conducted using IBM SPSS version 24 (SPSS an IBM Company, 2017). Any further calculations needed and the graphical representation of data was carried out by using MS Excel 2010 (Microsoft, 2010).

The following section elaborates on the ethical considerations for the study.

2.8. Ethical considerations

Apart from having to abide by the law in general as regards to data protection rights of individuals; whether it is permissible to offer incentives for participation; intellectual property rights; restriction on the types of technology permissible for use and investigating, it is important to behave ethically when doing research and to conduct ethical research (Oates, 2006). According to Olivier (2004), any research that involves human participants should be reviewed by an ethics committee in order to determine whether the research should be allowed to proceed or not.

It is important to apply for ethical clearance as soon as possible after the research proposal and the instruments for the study have been finalised. In this study application forms for ethical clearance were completed and submitted (on 24 October 2014) to the research ethical clearance (REC) committee of the University of South Africa (UNISA) where the researcher is a registered student (Application number: 183/MMV/2014). The details of the issues that were considered in the applications for ethical clearance included the following:

- Description of the research project (purpose, aims, objectives, nature and requirements of the research).
- Participants involved (who and how – adults or minors, how they will be selected - sampling, potential risks of harm from research, benefits from research, incentives).
- Storage and future use of research information.
- Costs and sponsors involved.

Ethical clearance for the research study was granted on 16 January 2015, by the College of Science, Engineering and Technology's (CSET) research and ethics committee, which is part of the University of South Africa (UNISA) (cf. Appendix A).

It should be noted that a consent form for the purpose of obtaining consent for participation from respondents accompanied each questionnaire, and was read and signed by each participant before completion of the questionnaire. A copy of the consent form is attached in Appendix C. Participants were furthermore reminded that their participation was voluntary and that their answers would remain confidential.

2.9. Conclusion

The formulation of the main research question of the study was informed by the researcher's experiences, literature reviews, discussions with supervisors and other experts in the field. The study was initiated by an identified problem in the public TVET College sector.

The information systems research framework, as presented by Hevner *et al*. (2004), informed the theoretical framework of the study (cf. section 2.4.2). The study was conducted according to the design science research (DSR) philosophical paradigm and was supported by the pragmatic philosophical paradigm. It utilised the activities described by Peffers *et al*. (2006) in the design science research process (DSRP) model to perform the investigation of the research problem, the subsequent research questions as stated in section 1.2.3, and the development of the required artefact.

The literature reviews, recorded in Chapters 3, 4 and 5, formed part of the construction of the artefact. The conceptual framework of the artefact (the TVET-MIS-EVAL methodology) was informed by the design science research methodology (DSRM) proposed by Peffers *et al*. (2008) and consisted of five components namely: Phase A: Principles; Phase B: Guidelines, practices and rules; Phase C: Procedures; Phase D: Toolkit; and Phase E: Standards and values.

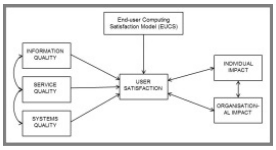
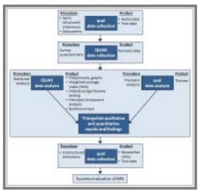
It is important to distinguish between the different underpinning theories of the study and the theories that informed the TVET-MIS-EVAL methodology. Table 2.8 presents the two sets of theories.

Table 2.8. Differences between the supporting theories of the research design of the study and the artefact.

Aspect	Study	Developed artefact – TVET-MIS-EVAL methodology
Philosophical paradigm	Design science research supported by pragmatism.	Pragmatism supported by interpretivism and post-positivism.
Underpinning conceptual framework	Information systems research framework presented by Hevner *et al*. (2004).	Design Science Research Methodology (DSRM) proposed by Peffers *et al*. (2008).
Guidelines	Seven design science research guidelines suggested by Hevner *et al*. (2004, p. 83).	One of the components of the artefact namely, *Phase B: Guidelines, practices and rules*, were informed by the seven Design Science Research guidelines suggested by Hevner *et al*. (2004).
Process model	Design science research process (DSRP) model by Peffers *et al*. (2006, p. 93).	SA-FETMIS success model as suggested by Visser *et al*. (2012; 2013), supported by mixed-methods (Creswell, 2014).
Data collection	During the evaluation activity of the DSRP model: Collect quantitative and qualitative data during demonstration and evaluation of the artefact.	Quantitative and qualitative data collection by using semi-structured interviews and a survey questionnaire.
Data analysis	Evaluation activity: Analyse quantitative and qualitative data during demonstration and evaluation of the artefact.	Quantitative and qualitative data analyses by using statistical methods and themes respectively.

By looking closely at the components of the artefact, as depicted in Table 2.9, Phase A and Phase B were informed by the problem statement presented in Chapter 1 and the context of the public TVET College sector discussed in Chapter 5. The seven design science research guidelines suggested by Hevner *et al*. (2004) informed Phase B. Phase C, which consists of the procedures utilised as part of the artefact, was informed by the SA-FETMIS model proposed by Visser *et al*. (2012; 2013) and by a mixed-methods approach as discussed in Chapter 6, section 6.3.3. Chapter 6 presents the developed TVET-MIS-EVAL methodology.

Table 2.9. Theoretical support for each component of the artefact (cf. Chapter 6).

	Component of the artefact	**Theoretical support**
Framework adapted from DSRM suggested by Peffers *et al*. (2008).	Phase A: Principles	Informed by the literature reviews captured in Chapter 1 to Chapter 5.
	Phase B: Practices and rules	Informed by the literature review captured in Chapter 5 and also adapted from the seven design science research guidelines suggested by Hevner *et al*. (2004).
	Phase C: Procedures	Based on the SA-FETMIS success model as suggested by Visser *et al*. (2012; 2013), and supported by a mixed-methods approach (Creswell, 2014). Make use of interview and survey strategies. 
	Phase D: Toolkit	Data collection tools: semi-structured interview schedule and survey questionnaire. Data analysis methods: Statistical methods for quantitative data and theme analysis for qualitative data.
	Phase E: Standards and values	Measurement values for the constructs (systems quality, information quality, service quality, user satisfaction, individual impact and organisational impact) are derived from applying Phase C and Phase D and these inform the standards and values which form the output from applying the TVET-MIS-EVAL methodology.

The following chapters correspond to the different research process model activities of the study (which was informed by the DSRP model activities suggested by Peffers *et al*. [2006]), as described and illustrated in section 2.5.

In Chapter 1 the problem statement and purpose, including the research goal, rationale, research questions and objectives, were explicated. This correlates with the first DSRP model activity namely: *Problem identification and motivation of relevance*.

Literature studies on the three knowledge domains of the study, namely: the development of methodologies as artefacts (cf. Chapter 3), models for IS success evaluation in the literature (cf. Chapter 4) and the context of the study, the MISs within the public TVET College sector in South Africa (cf. Chapter 5), are presented and form the building blocks for the construction of the artefact. These chapters address the second DSRP activity which is: *Define objectives for a solution*. Chapter 6, in which the developed TVET-MIS-EVAL methodology (artefact) is presented and described, relates to the third DSRP activity which is: *Design and development of the artefact*.

The developed artefact was demonstrated and evaluated on a sample of three public TVET Colleges, which was selected by using a cluster-random selection technique. A comprehensive discussion of the cluster-random sampling technique utilised for sample selection, for the demonstration and evaluation activities, is provided in Chapter 7. Information about the findings in terms of the demonstration and evaluation of the developed TVET-MIS-EVAL methodology (artefact) is provided in Chapter 8. This corresponds to the fourth and fifth DSRP activities: *demonstration* and *evaluation*.

The final chapter of the thesis provides a discussion, conclusion and reflection on the study, which correspond to the final DSRP model activity of *communication* of the problem and its importance, the developed artefact, and its utility and novelty. It also describes the rigour and effectiveness of the solution whilst discussing the contribution of the study to the knowledge base in terms of theoretical contribution, contribution to research methods, and practical contribution.

CHAPTER 3. COMPONENTS OF A METHODOLOGY

3.1. Introduction

The aim of this chapter is to present a framework for the development of a methodology suitable for the evaluation of management information systems (MISs) at public Technical and Vocational Education and Training (TVET) Colleges in South Africa. Thus, the first sub-research question in support of the main research question: *What are the components of a methodology?* (cf. section 1.2.3.2) is addressed in this chapter. The literature review presented herein therefore focuses on definitions and descriptions of concepts, constructs and components within the knowledge domain of methods, methodologies and paradigms.

The chapter is structured as follows: in section 3.2 specific concepts are defined and explicated; findings on a literature review on evaluation methodologies are presented in section 3.3; and in section 3.4 examples of methodologies in the information systems (IS) discipline found in the literature are discussed. Thus the information presented in this chapter should be regarded as the first step in the development of a methodology (artefact) for the evaluation of Management Information Systems (MISs) deployed at public Technical and Vocational Education and Training (TVET) Colleges in South Africa by searching for the building blocks or components of a methodology and the relevant underpinning theories.

The investigation covers one of the aspects within Phase 3 of the research process of the study described in section 1.3.4 namely: *define objectives of a solution,* which is the second activity in the DSRP model (Peffers *et al.*, 2006, p. 93) as shaded in Figure 3.1.

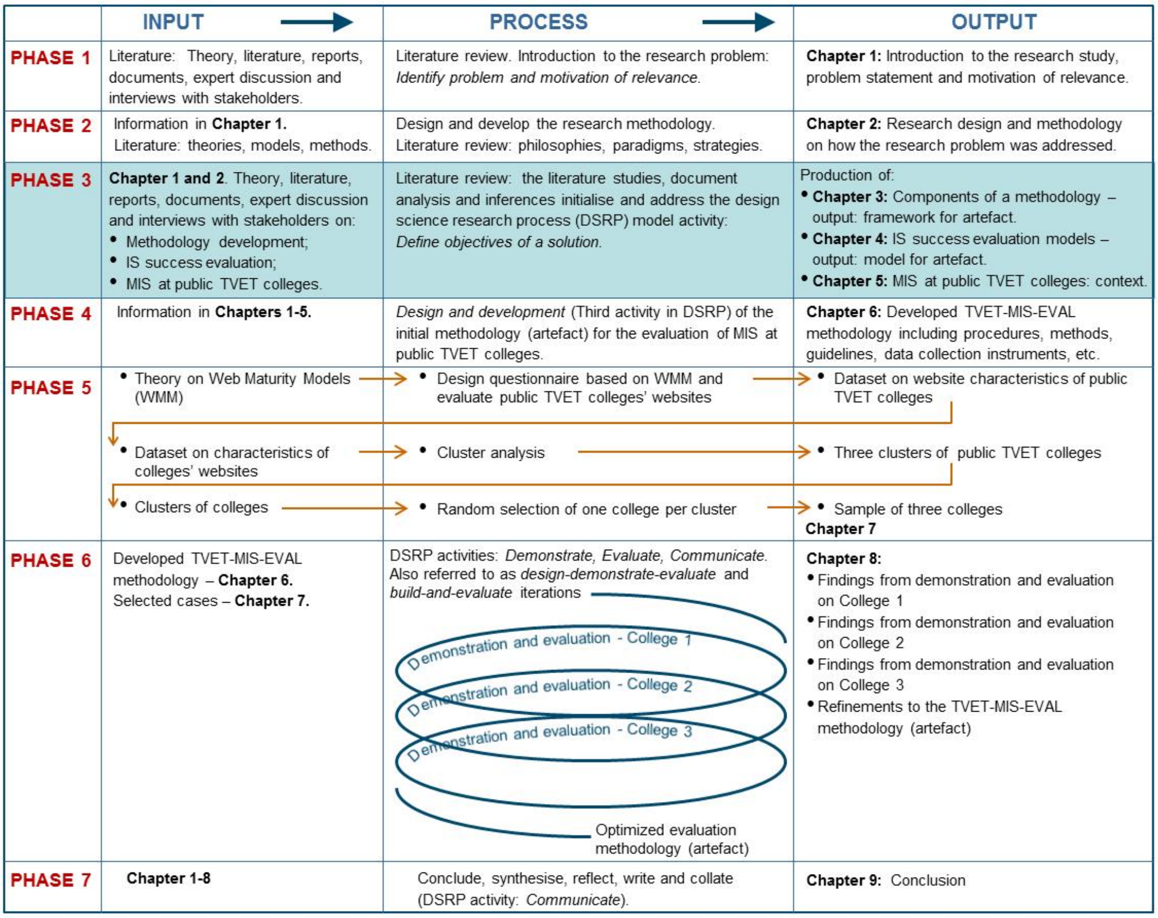


Figure 3.1. Research process of the study delineated by phases, inputs, activities and outputs, underpinned by the design science research process (DSRP) model (Peffers *et al.*, 2006, p. 93).

In Figure 3.2, the part of the framework for the systematic literature review (which was introduced in section 1.3.1) relevant to this chapter is highlighted. The literature overview for this chapter started with keyword searches on: *methodology*; *evaluation methodology*; *methodology component* and *methodology artefact*. The systematic process through which literature sources were retrieved employed the ABI/INFORM™ complete database provided by ProQuest. Subsequent to keyword searches, more literature resources were found by using literature review techniques as defined and explained in Table 1.1. Thus, literature searches initially started with high level main keywords, but more searches on keywords and references found in the initially collected sources were conducted afterwards in a snowballing manner.

Table 3.1 presents the results of the systematic literature overview for the purpose of indicating scope. Since the term *methodology* is commonly used to indicate the set of methods utilised to conduct a research study, it was decided to launch the main keyword searches only on titles of literature sources. Relevant literature was selected for further scrutiny by reading through the full titles of the resources, and if believed relevant, the abstracts were evaluated for inclusion.

Table 3.1. Results of the systematic literature overview to indicate scope. Adapted from Levy and Ellis (2006) and Webster and Watson (2002).

ABI/INFORM™ Keyword search	Search criteria	Results: (Number of related articles)
Methodology	ti(Methodology); full-text; peer reviewed; all dates.	2 662
Evaluation methodology	ti(Evaluation) AND ti(Methodology); full-text; peer reviewed; all dates.	99
Methodology component	ti(Methodology) AND ti(Component); full-text; peer reviewed; all dates.	15
Methodology artefact	ti(Methodology) AND ti(Artefact); full-text; peer reviewed; all dates.	247

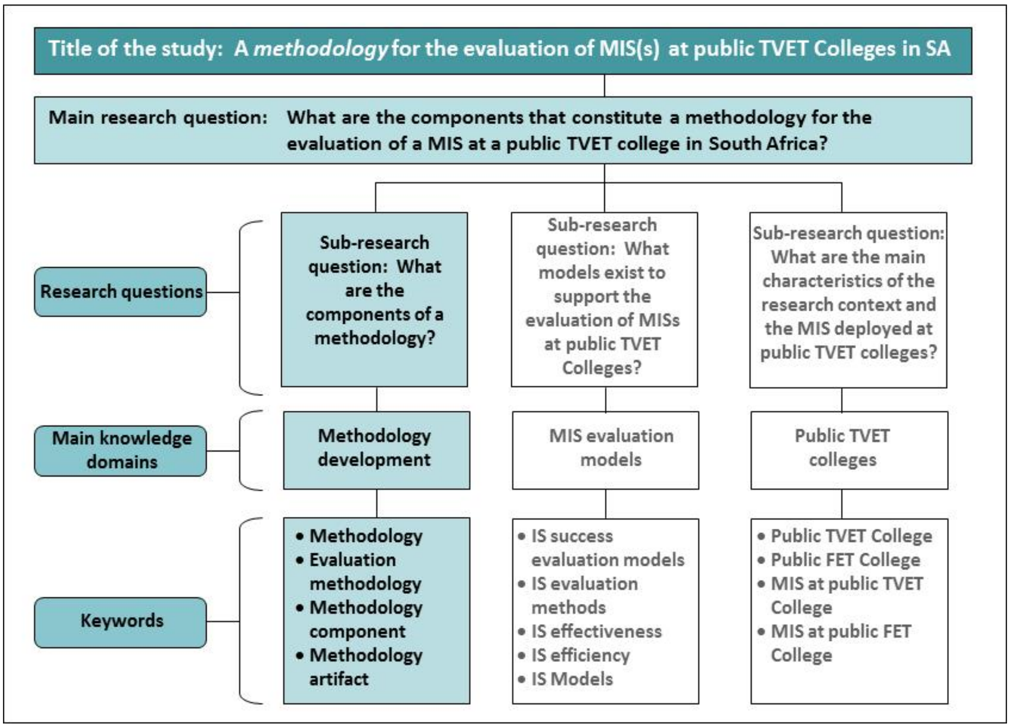


Figure 3.2. Framework for the systematic literature review of the study.

The following section provides definitions of key concepts utilised in this knowledge domain.

3.2. Terms and definitions

McGregor and Murnane (2010) acknowledge that the three interrelated concepts: method, methodology and paradigm are inconsistently used in the literature. Many scholars do not clearly differentiate between these concepts and in many instances they are incorrectly used interchangeably. The following sections elucidate the distinct difference between these concepts. In this section the meaning of the terms: method, methodology and paradigm are clarified.

3.2.1. Method

The American Heritage Dictionary (2009), accessed online, defines the term *method* as:

- “A means or manner of procedure, especially a regular and systematic way of accomplishing something;
- orderly arrangement of parts or steps to accomplish an end;
- the procedures and techniques characteristic of a particular discipline or field of knowledge” (Houghton Mifflin Company, 2009).

Goldkuhl and Lind (2010, p. 46) define a method as a set of steps (an algorithm or guideline) to perform a task. Research methods are the tools, techniques or processes used during a scientific investigation and can, for example, include surveys, interviews, photovoice or participant observation. Methods are characterised as either qualitative or quantitative (Kinash, 2006, p. 6).

In a design science research paradigm a *method* (artefact) defines processes. A method provides guidance on solving a problem, by searching through the “solution space” (Hevner *et al.*, 2004, p. 79). These methods (artefacts) can range from formal mathematical algorithms that explicitly define the search process to informal, textual descriptions of best practice approaches, or some combination of the two (Hevner *et al.*, 2004, p. 79).

3.2.2. Methodology

The American Heritage Dictionary (2009), accessed online, defines the term: *methodology* as follows:

- "A body of practices, procedures, and rules used by those who work in a discipline or engage in an inquiry;
- a set of working methods including the study or theoretical analysis of such working methods;
- The branch of logic that deals with the general principles of the formation of knowledge" (Houghton Mifflin Company, 2009).

Irny and Rose (2005) explain that a methodology is generally a guideline for solving a problem and it includes components such as phases, tasks, methods, techniques and tools. Robson (1997) furthermore suggests that methodologies generally encompass the following four elements:

- provide an opinion of what needs to be solved;
- define techniques on what has to be done and when it should be done;
- advise on how to manage the quality of deliverables or products; and
- provide a toolkit to facilitate the process (Robson, 1997).

Arbnor and Bjerke (2009, p. 3) argue that a *methodology* is a mode of thinking, but also a mode of acting. It contains a number of concepts which try to describe the steps and relations needed in the process of creating and searching for new knowledge to solve problems (Arbnor & Bjerke, 2009, p. 3). A methodology is also described as a system of broad principles or rules (that guide research practices) from which specific methods or procedures may be derived to interpret or solve different problems within the scope of a particular discipline. A methodology is not a formula like an algorithm, it is a set of practices (WebFinance, 2015) which is guided by a set of principles and a common philosophy for solving targeted problems (Checkland, 1981). In the context of research "a discipline's methodology, broadly defined, is its body of methods, approaches, rules, and techniques" (Weiss, 2005, p. 1).

Mingers (2001) synthesises various authors' definitions of a methodology and states that the term *methodology*, could be interpreted in three different ways. Firstly, it could refer to the study of methods; secondly, it could refer to a methodology of a specific study; and thirdly, it could refer to a generalisation of a specific methodology. Explanations of the three types are provided in the following sections.

3.2.2.1. Study of methods

In this context, the term 'method-ology' means the study of methods (Checkland, 1981; Mingers, 2001). Here one would refer to a programme or course in Research Methodology which includes a range of different methods. In this context, a methodology is a systematic, theoretical analysis of the methods applied to a field of study and does not set out to provide solutions (Irny & Rose, 2005, p. 330). Methods are categorised as either quantitative or qualitative. A qualitative methodology includes a set of qualitative methods; similarly, a quantitative methodology includes a set of quantitative methods and a mixed-methods methodology includes both quantitative and qualitative methods.

3.2.2.2. Methodology of a specific study

In this instance the term refers to a specific set of research methods utilised in a particular research project, or study, to provide or suggest a solution to a specific problem. Every research study has its own individual methodology (Mingers, 2001). Irny and Rose (2005) categorise this type of methodology as specific-to-context methodologies. From a practical business perspective, this type of methodology, as developed and applied within an organisation, is "… all about cementing credibility in our practice and consistency in our approach", as Jeffrey McIntire mentioned in his 2010 Web Content talk (Mcintire, 2010).

3.2.2.3. Generalisation of a specific methodology

In practice, particular combinations of methods are used many times or are deliberately designed a priori. By using the term *methodology* in this manner, a more general and less prescriptive process than a method is implied (Irny & Rose, 2005). According to Mingers "it is a structured set of guidelines or activities to assist in generating valid and reliable research results. It will often consist of various methods or techniques, not all of which need to be used every time" (2001, p. 242). Mingers (2001) adds that it can be difficult to precisely delineate the boundaries between method and methodology at one end (e.g. administering and analysing a survey), or between methodology and a general research approach (e.g. qualitative research methodology) at the other. A methodology could therefore be concerned with combining research methods, but it is also possible to combine these more generic methodologies.

It is envisaged that the methodology (artefact) developed in this study will fit into this category.

The meaning of the third concept: *paradigm* is presented in the following section.

3.2.3. Paradigm

The American Heritage Dictionary (2009), accessed online, defines the term: *paradigm* as a “set of assumptions, concepts, values, and practices that constitutes a way of viewing reality for the community that shares them” (Houghton Mifflin Company, 2009). Kuhn (1970) explains that a paradigm includes an accepted body of rules and techniques for solving problems within a specific community of practice and that research is guided by paradigms through direct modelling as well as abstracted rules.

McGregor and Murnane (2010, p. 420) define the term *paradigm* to encompass two dimensions namely *philosophical*: basic beliefs and assumptions about the world, and *technical*: the methods and techniques adopted when conducting research. The authors furthermore explain that a methodology represents the philosophical underpinning of a paradigm, and its methods and how they are used are shaped by this methodology. Hence, a specific methodology explains why certain methods or tools are used. A methodology offers the theoretical underpinning for understanding which method, set of methods, or so-called *best practices* can be applied to a specific case (Kuhn, 1970).

3.2.4. Delineation of the term methodology as used in this study

The methodology (artefact) developed in this study falls in the category as described in section 3.2.2.3. The developed artefact will be a generalised methodology (artefact) that can be applied in the domain of success evaluation of MIS at public TVET Colleges.

In addition, it is important to distinguish between the different connotations of the term *methodology* as used in this study. The term *methodology* was used in four contexts namely:

- The final product of this study was an artefact called a *methodology* for the evaluation of the success of MISs deployed at public TVET Colleges. To enable distinctive identification of this *methodology,* it will henceforth be referred to as the TVET-MIS-EVAL methodology.
- Another context in which the term *methodology* was utilised is located in Chapter 2, in which the specific research design and methodology of this study are explicated.
- Additionally, within the underpinning philosophical paradigm of the study, which is design science (DS), the design science research methodology (DSRM) with its design science research process (DSRP) model was also referred to in this study. The DSRP model informed the research process of the study.
- Finally, in Chapter 7, a methodology was used for the selection of the sample of cases on which the artefact (TVET-MIS-EVAL methodology) was demonstrated and evaluated. This methodology entailed the development of a questionnaire based on web maturity models theory and the clustering of the population of public TVET Colleges.

The following section provides information regarding the theory that underpins the context (methodological views) in which methodologies can be utilised.

3.2.5. Methodological views

Arbnor and Bjerke (2009, p. 7) identify different *methodological views* based on when and how these methods are used for studying and researching reality. The authors argue that a methodological view is its concepts. Methodological views make ultimate presumptions (from background information) about reality. The authors see methodologies as guiding principles for the creation of knowledge. In order to be useful and effective, these principles must fit both the problem under consideration and the ultimate presumption (Arbnor & Bjerke, 2009, p. 11). The authors furthermore describe three methodological views namely: the *analytical view*, the *system's view* and the *actor's view* (Arbnor & Bjerke, 2009, p. 19).

A methodology in the *analytical view* explains causality in reality where said reality is presumed to be based on facts. There exist subjective facts and objective facts. Concepts of the analytical view include: reality and models, deduction, hypotheses, causal relations, induction and verification and analyses (Arbnor & Bjerke, 2009).

A methodology in the *system's view* explains and understands reality, presumed to be built up holistically. The systems view includes three overlapping philosophies namely: systems theory, holism and structuralism. Systems theory is the interdisciplinary study of organisations including systems language and thinking. Structuralism includes theories across social sciences and humanities which assume that much can be learnt from structured relationships. Holism propagates the idea that a system under investigation cannot be explained, understood or determined by its components alone. It is believed that the system determines *how* the components behave (Arbnor & Bjerke, 2009).

Finally, a methodology in the *actor's view* is devoted to understanding, creating and giving meaning in reality, where the reality is presumed to be socially constructed (Arbnor & Bjerke, 2009, pp. 417–426). Knowledge created in accordance with this view depends on how individuals perceive, act and interpret the reality that they have helped to create (Arbnor & Bjerke, 2009).

The TVET-MIS-EVAL methodology (artefact) fits within an *analytical view.*

The following theoretical concepts within the theory of *methodological views* are worth mentioning. *Methodological procedure* is a concept that refers to the manner in which the researcher incorporates, develops and/or modifies some previous technique in a methodological view. The way in which the researcher relates to, and incorporates these techniques into the study process, planning and execution is called *methodics* (Arbnor & Bjerke, 2009, p. 17).

The following section provides information about evaluation methodologies, practices and theories.

3.3. Evaluation methodology

Evaluation methodologies are guided by evaluation theory (Mark, 2005). Evaluation theory develops from empirical evidence through practices of evaluation methodologies. Some critical views in the literature suggest that evaluation is a field of practice and that the role of theory is therefore unclear (King, 2014). These theorists refer to evaluation theory as "theories of evaluation practice" (McNall, 2009, p. 8). Nonetheless, there exists a large body of knowledge about evaluation theory, methodology and practice in the literature to which the following literature sources attest: Duignan (2001); Mark (2005); Weiss (2005); Trochim (2006); Patton (2010); Alkin (2013); Pawson (2013) and King (2014).

3.3.1. Definition of evaluation

The practice of evaluation involves the systematic collection of information about the object or subject under evaluation. Evaluation can be conducted on activities, characteristics, outcomes of programmes, personnel and products. The outcome of an evaluation is used by specific people to reduce uncertainties, improve effectiveness and make decisions with regard to what the object or subject under evaluation is doing and affecting (Patton, 1982). Trochim (2006) defines the concept, *evaluation,* on his website as follows: "Evaluation is the systematic acquisition and assessment of information to provide useful feedback about some object". Hence, the goal of an evaluation is to systematically gather information to "provide useful feedback" about objects such as a system, programme, policy, person, technology, a need or an activity being evaluated.

3.3.2. Evaluation theory

Alkin (2013, p. 12) explains the overarching domains of evaluation by using a tree as metaphor to illustrate the purposes and development of the theory of evaluation. Authors who contribute to the growth of the tree are noted on the tree in Figure 3.3. According to Alkin (2013), the tree is an oversimplification of complex relationships between authors and research topics. One should also consider the growth of the field of evaluation - for example emerging researchers and new research topics will influence the growth (size and shape) of the theory tree in future. Figure 3.3 depicts a modified version of Alkin's initial illustration of the evaluation theory tree. The modified version is proposed by Carden and Alkin (2012, p. 114). The names of researchers who contributed to the different branches are included in Figure 3.3 for illustration purposes only.

Alkin (2013) states that the foundation from which evaluation theory emerged consists of three roots namely: social accountability, systematic social inquiry and epistemology. *Social accountability* serves as the motivation for evaluation with the focus on the improvement of programmes and society. The branch labelled *use* grows from the *social accountability* root and focuses on the use of the evaluation information, for instance, for decision-making and to inform policy development.

Systematic social inquiry originates from the need to utilise appropriate methods and justifiable procedures to determine accountability. In the *method* branch, which grows from the *systematic social inquiry* root, evaluation is guided by the *research methodology* (e.g. methods, techniques and processes) of a study.

Epistemology is the root that speaks to the validity and nature of knowledge. Studies in the *valuing* branch, which grows from the epistemology root, recognise the essential role of *valuing* in evaluation and emphasise the importance of the subject of evaluation. This branch is therefore divided into two fundamental perspectives namely: subjectivism and objectivism.

Apart from the three branches suggested by Alkin (2013), Shadish, Cook and Leviton (1991) propose two additional theory branches namely: the theory of social programming and the theory of practice.

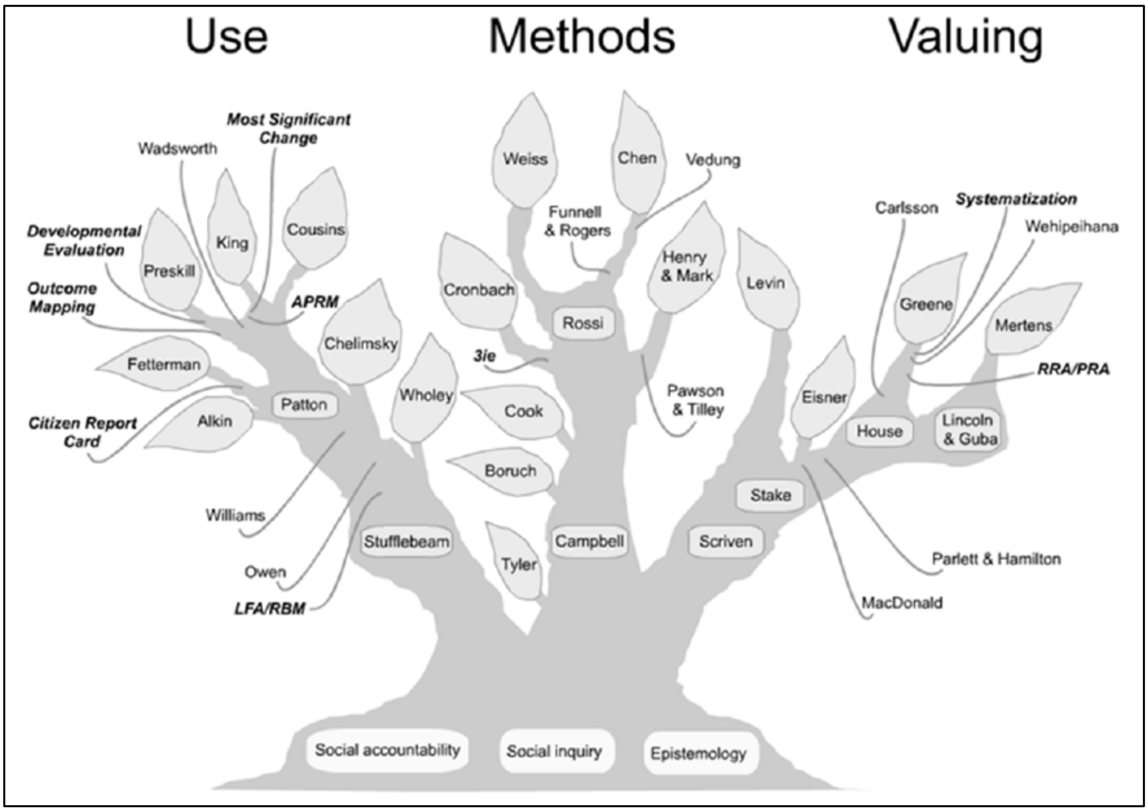


Figure 3.3. Modified Evaluation theory tree (Carden & Alkin, 2012, p. 114).

In addition, evaluation theories are distinguished by the extent to which emphasis is placed on use, methods or valuing and whether it utilises a prescriptive or descriptive model (Alkin, 2013). A prescriptive model is "a set of rules, prescriptions, prohibitions, and guiding frameworks that specify what a good or proper evaluation is and how evaluation should be done" (Alkin, 2013, p. 4). A descriptive model is "a set of statements and generalisations that describe, predict, or explain evaluation activities – such a model is designed to offer an empirical theory" (Alkin, 2013, p. 4).

3.3.3. Evaluation methods

The study field of *evaluation* is interdisciplinary and utilises methods, approaches, rules and techniques of disciplines such as communication, psychology, public health, information systems and many other disciplines

(Weiss, 2005). Therefore, the evaluation discipline enjoys a variety and richness in its methodology. It utilises multi-methods and is multi-evidence based (Pawson, 2013). Although evaluation methodologies are grounded in the social science approaches, they entail more than just the application of social science methods but require the integration of empirical evidence with standards and values to make judgements and to facilitate evaluative conclusions and decisions (Weiss, 2005).

To conduct periodical systematic evaluation, through the use of various methods, can provide considerable benefits to an organisation as it creates multiple lines of evidence that can support decision-making in an organisation (Pawson, 2013). The task of *evaluating* is considered good management practice as it assists managers in planning, verifying, communicating new and ongoing decisions and reviewing accountability (Ruegg, 2007). There is broad consensus that an evaluation should be conducted to influence decision-making and to inform policy development by providing empirically-driven evidence and feedback (Korporowicz, 1997; Weiss, 2005; Trochim, 2006).

Trochim (2006) identifies four classes of evaluation strategies which are based on:

- *Scientific-experimental models* which take their values and methods from, especially, the social sciences. Emphasis is placed on accuracy, impartiality, objectivity and validity of the information generated. The models are based on experimental and quasi-experimental, objectives-based research. Econometrically-oriented and theory-driven evaluations are also included here.
- *Management-oriented system models* of which the Programme Evaluation and Review Technique (PERT) and the Critical Path Method (CPM) are commonly known. In these strategies evaluation is placed within a large framework of organisational activities.
- *Qualitative or anthropological models* value subjective human interpretation, observation and the importance of the phenomenological quality of the evaluation context. Approaches such as interpretivism,

critical theory, grounded theory and various other qualitative schools are included.

- *Participant-oriented models* value the participant conducting the evaluation. Participants mainly include users (of a programme, system or technology) and clients (Trochim, 2006).

The TVET-MIS-EVAL methodology (artefact) will be participant-oriented and will utilise qualitative models and strategies and will also be suitable, after development, to be used as part of the activities in a management-oriented system model.

Duignan (2001) provides a comprehensive list of evaluation strategies, purposes, methods and designs as presented in Table 3.2. The original table can be found on the author's website (http://www.parkerduignan.com/documents/104.htm). Table 3.2 provides examples of evaluation approaches which generally include a philosophy and a set of values. Duignan (2001) explains the different approaches to evaluations as follows:

- In *Utilisation-focused evaluation,* methods are selected by focusing on those methods that will be the most useful to different audiences.
- In *Empowerment evaluation,* the methods chosen should be empowering to those who are being evaluated.
- *Stakeholder evaluation* focuses on aspects of interest to all of a programme's stakeholders.
- In *Goal-free evaluation* an evaluator must evaluate all outcomes of a programme, not only the formal outcomes as noted in the objectives.
- *Naturalistic or 4th generation evaluation* focuses on the qualitative uniqueness of programmes as an enhancement to quantitative evaluation approaches.
- *Theory Based Evaluation* is directed by the detailed assumptions on which a programme is based and evaluate if these objectives have been achieved.

- Cultural specific research or evaluation focuses on evaluation that takes into account the cultural specific values, perspectives and research methods.
- In *Strategic evaluation* the decisions regarding evaluation are driven by the strategic value of the information they will provide for solving social problems (Duignan, 2001).

The TVET-MIS_EVAL methodology (artefact) will be an utilisation-focused evaluation tool for the purpose of evaluating the success of MISs at public TVET Colleges to inform decision-making on institutional and national levels and influence policy development. Patton (2010, p. 10) defines utilisation-focused evaluation (U-FE) as “a decision-making framework for enhancing the utility and actual use of evaluations”. The author furthermore states that the goal of U-FE is the “intended use by intended users” (Patton, 2010, p. 17). The TVET-MIS-EVAL methodology will furthermore employ the methods and designs as highlighted in Table 3.2. The description of the developed TVET-MIS-EVAL methodology will be presented in Chapter 6.

Table 3.2. Strategies, purposes, methods and designs for evaluation (Duignan, 2001).

Strategies	Purposes	Methods	Designs
Utilisation-focused evaluation Empowerment evaluation Stakeholder evaluation Goal-free evaluation Naturalistic or 4th generation evaluation Theory Based Evaluation Cultural specific research/evaluation Strategic evaluation	Formative Evaluation: *- Design* *- Developmental* *- Formative* *- Implementation* Process Evaluation Outcome Evaluation: *- Impact* *- Outcome* *- Summative*	Consultation Literature review (prospective evaluation synthesis) Evaluative review of lessons from other existing programmes Evaluative goal and objective setting critique Evaluative implementation (programme) logic critique Formative evaluation workshops for centrally funded community programmes Stakeholder workshops Pretesting for programme resource development Piloting Archival, administrative/routine records collection Evaluation specific records collection Observation and environmental audit Participant observation Photos, video and audio Document analysis Interviews: key informant/participant Surveys, questionnaires, feedback sheets Focus groups Each of these methods may involve the following: *- Expert assessment* *- Statistical analysis* *- Qualitative analysis* *- Economic evaluation*	Experimental designs Quasi experimental designs: *-Non-intervention control group with pre-test and post-test* *- Non-equivalent dependent variables;* *- Removed intervention design with pre-test and post-test* *- Repeated intervention design;* *- Reversed-intervention non-equivalent control group design with pre-test and post-test; cohort designs in formal and informal institutions with cyclical turnover;* *- Post-test-only design with predicted higher-order interaction;* *- Regression-discontinuity design* Case study designs: *- Illustrative* *- Exploratory* *- Critical instance* *- Programme implementation* *- Programme effects* *- Cumulative*

Note: The shaded text in Table 3.2 is identified as relevant to the development of the TVET-MIS-EVAL methodology.

3.3.4. Evaluation types and uses

Many different types of evaluation, when to use them, what they reveal and why they are useful are identified in the literature (Duignan, 2001; Weiss, 2005; Trochim, 2006; Sweeney & Pritchard, 2010; CDC, 2016). It was also noted that the type of evaluation depends on the object being evaluated and the purpose of the evaluation (Trochim, 2006). The most important distinction in evaluation types, based on the purpose of the evaluation, is between *formative* and *summative* evaluations. There are theorists that claim that developmental evaluation should be a separate category while other theorists consider it to be an example of formative evaluation (King, 2014). Duignan (2001) provides a third evaluation type namely *process* evaluation.

Figure 3.4 depicts a project evaluation cycle. *Formative* evaluation happens mainly during the development and implementation phases of a project and *summative* evaluation takes place after implementation of the project. *Process* evaluation refers to any evaluative activity that documents, or describes, what happened in the course of the programme once it has been implemented (Duignan, 2001).

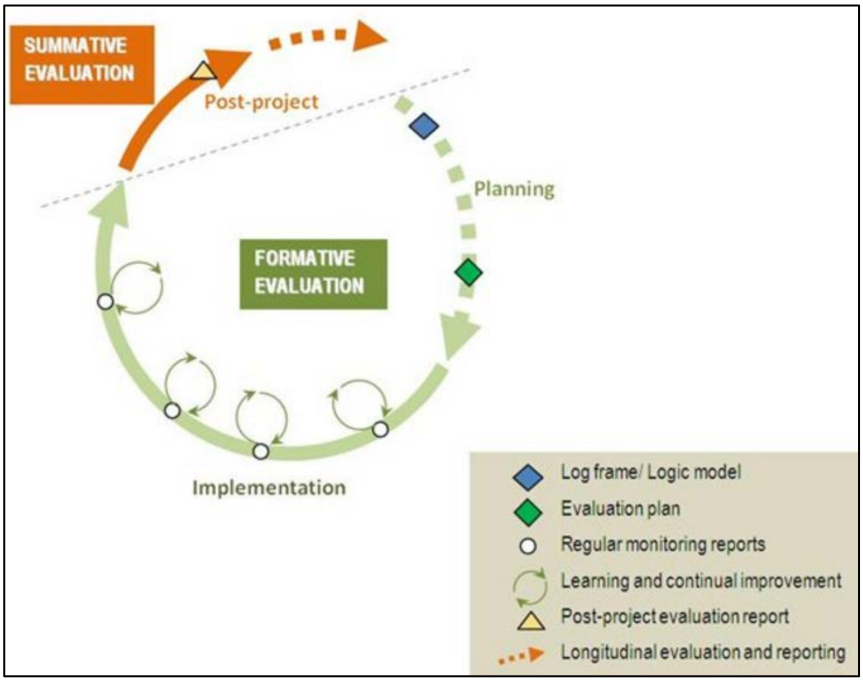


Figure 3.4. Project evaluation cycle (Sweeney & Pritchard, 2010).

3.3.4.1. Formative evaluation

Formative evaluation includes any evaluation activity that aims to improve a programme's design, planning, development and implementation (Duignan, 2001). Formative evaluation includes: needs assessments; evaluability assessments; structured conceptualisation; implementation evaluation and process evaluation.

3.3.4.2. Summative evaluation

Examples of summative evaluation include: outcome evaluation; impact evaluation; cost-effectiveness and cost-benefit analysis; secondary analysis and meta-analysis (Duignan, 2001; Sweeney & Pritchard, 2010).

Both summative and formative evaluation types are relevant in this study. In the evaluation activity of the design science research process model, the management information systems deployed at the selected college cases will undergo summative success evaluation while the TVET-MIS-EVAL methodology will be subjected to formative evaluation.

Examples of methodologies are provided in the next section.

3.4. Exemplars of methodologies in information systems research

There exists in the literature a plethora of examples of methodologies as well as specific applications of evaluation methodologies across disciplines. Each example provides valuable insights and lessons to be learnt in the design, implementation and application of methodologies. In this section three examples of methodologies are discussed for the purpose of providing a theoretical foundation for the TVET-MIS-EVAL methodology (artefact). The core and commonly utilised elements and components of evaluation methodologies are provided in the conclusion.

It is essential to utilise a systematic and well-planned evaluation process to ensure that decisions with serious consequences can be made, and documented, with confidence. A thorough planning process furthermore reduces the occurrence of bias from evaluations and justifies decisions. The quality of confidence in the results attained from a quality evaluation process justifies the effort to perform the process systematically (Baehr, 2004).

3.4.1. Example 1: A specific-to-context evaluation methodology

The evaluation methodology described in this section is suggested by Baehr (2004). It is a basic tool to assist in understanding the steps needed to conduct an evaluation. By following the process, an evaluator can determine the level of quality of a product. Baehr (2004, pp. 1–2) suggests the following steps and processes:

3.4.1.1. Step 1: Define the parameters of the evaluation

a. The first step is to determine the need for the evaluation. Having the purpose in place creates a framework for the design process.
b. It is required to know how the results are going to be used and what decisions need to be taken based on the results in advance. These will facilitate reliable criteria and determine the evidence needed.
c. Based on the rationale of the evaluation, it has to be decided if and how the results will be communicated to the clients.
d. Decisions will be made based on the evaluation, thus clients should communicate their needs clearly.
e. Before planning the methods of evaluation, it is important to sketch out: the time for completion, checks for reliability and lists of needed and unacceptable quality criteria. Developing these guidelines in advance ensures that the evaluation will align with the clients' needs.

3.4.1.2. Step 2: Design the methods used for the evaluation

a. The parameters set out in Step 1 should be utilised to assist in determining the criteria for the evaluation process.
b. Once the criteria are set, the evaluator determines what evidence should be collected. The time for collection, the cost, and the usefulness of the evidence must be considered in deciding what evidence to collect.

c. Particularly in indirect evaluation, a sample of performance is often used to determine quality. This sample must be unbiased and large enough for the results to be useful.
d. Determining how to collect the data includes deciding what form of evidence (e.g. a survey or interviews) will be used and how data will be collected.
e. The evidence collection plan includes *how*, *when* and *where* the information will be collected.

3.4.1.3. Step 3: Set standards and collect evidence

a. Once it is determined what evidence will be collected, a scale must be set to describe how the quality is to be judged. This scale could be a number scale, a rubric, or a description.
b. For the process to be unbiased, the client must decide before receiving the information from the evaluation, what the consequences will be based on the outcome of the evaluation. This could be, for instance, a simple process: high quality will be followed by positive consequences, low quality will be followed by negative consequences and for in-between the two, other evaluative methods will be used to determine the consequences.
c. Once the scale and the decisions to be made are known, the client can set standards for decisions. These standards define the *quality* based on what will be reported by the evaluator.
d. Following the plan in Step 2, the evaluator collects the needed information and analyses it.
e. The evaluator documents what has been found in the form of scores, level of performance, averages, or narratives. Results should be documented in a manner that assists the evaluator in writing the requested report for the client, using the scales that informed the setting of standards.

3.4.1.4. Step 4: Report and decisions

a. For criteria-based standards, after the client has set the standards, the evaluator can submit the report to the client, and the standards will not be biased by the evaluative outcome. For norm-based standards, the evaluator must include summaries of outcomes of all evaluations in the report.

b. Once the client has set the standards and has received the evaluator's report, the client can check the evaluative outcomes against the standards that have been set.
c. Based on the evaluative outcomes, the client makes the decisions and develops plans to implement them.
d. Anything that needs to be documented for future use should also be done at this point.
e. The contents of a report to the evaluatee, if appropriate, should be guided by the results of Step 1e.

3.4.2. Example 2: A specific-to-context methodology to institutionalise user experience in South African provincial government

Pretorius (2014) proposes a methodology for the institutionalisation of the practice of enhancing user experience (UX) of government websites (Figure 2.5). The author argues that the Internet provides excellent opportunities for government to communicate and offer services to the public. The aim of the proposed methodology is to assist government officials in implementing measures to ensure usable, findable, accessible, useful and credible websites which will increase their usage by citizens. The methodology is called the IUXG methodology (Institutionalise User Experience in Government methodology) and includes the following phases: start-up, setup, organisation, method, standards and long-term. The IUXG methodology provides organisations with a step-by-step method on how to institutionalise UX. The original focus was on government institutions, however, the methodology can be used and adopted by any organisation (Pretorius & Calitz, 2014).

Figure 3.5 depicts the six main phases and steps within each phase of the Institutionalise UX methodology:

Phase A: Start-up: start the UX initiative;

Phase B: Setup: establish the infrastructure;

Phase C: Organisation: develop the UX team;

Phase D: Method: the required steps for conducting a UX project;

Phase E: Standards: minimise rework and enforce consistency; and

Phase F: Long-term: long-term considerations in order to keep UX institutionalised.

It is clear from Figure 3.5 that the IUXG methodology consists of guidelines, methods, procedures, processes and standards.

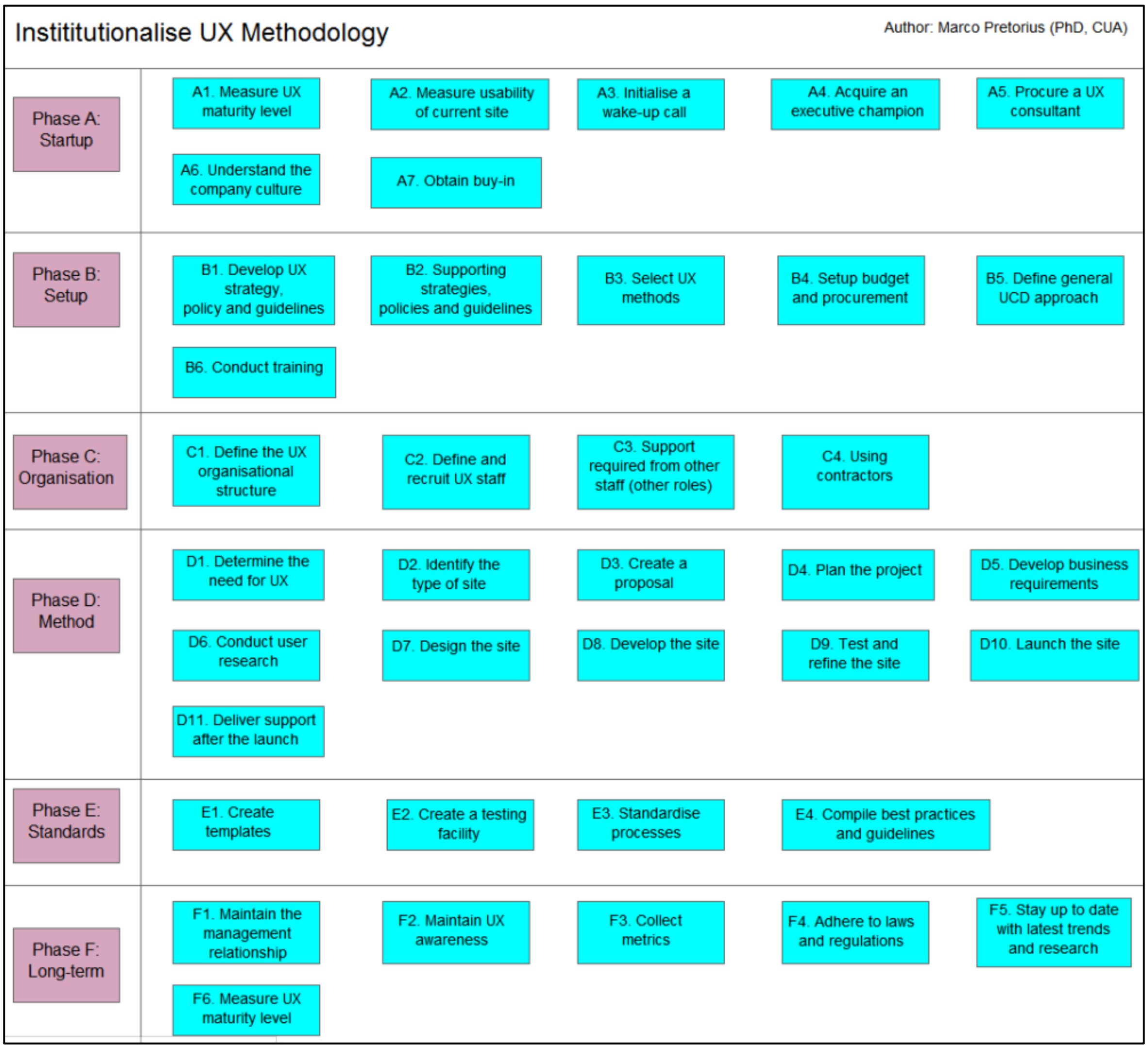


Figure 3.5. The framework of the IUXG methodology (Pretorius, 2012).

3.4.3. Example 3: A generalisation of a specific methodology

Peffers *et al*. (2008) propose a methodology that fits within the design science research paradigm in the information systems (IS) discipline called the design science research methodology (DSRM). The methodology incorporates those principles, practices and procedures required to conduct design science research in information systems.

3.4.3.1. Principle

The main principle in the DSRM in the information systems discipline is the creation of artefacts with an embedded solution to an understood organisational problem. These artefacts can be any object such as a construct, model, method, or instantiation. It can also include social innovations, new properties of technical, social or informational resources, as long as the artefact meets the condition of providing a solution to a business problem (Peffers *et al.*, 2008, p. 59).

3.4.3.2. Practices and rules

The set of seven guidelines, as suggested by Hevner *et al*. (2004, p. 83), is adopted by Peffers *et al*. (2008) as the component containing practicing rules as part of the DSRM (cf. Table 3.3). These rules provide guidance for the execution and justification of design science research in IS.

Table 3.3. Design science research guidelines (Hevner *et al.*, 2004, p. 83).

Guideline	Description
Guideline 1: Design as an artefact	Design science research must produce a viable artefact in the form of a construct, a model, a method, or an instantiation.
Guideline 2: Problem relevance	The objective of design science research is to develop technology-based solutions to important and relevant business problems.
Guideline 3: Design evaluation	The utility, quality, and efficacy of a design artefact must be rigorously demonstrated via well-executed evaluation methods.
Guideline 4: Research contributions	Effective design science research must provide clear and verifiable contributions in the areas of the design artefact, design foundations, and/or design methodologies.
Guideline 5: Research rigour	Design science research relies upon the application of rigorous methods in both the construction and

Guideline	Description
	evaluation of the design artefact.
Guideline 6: Design as a search process	The search for an effective artefact requires utilising available means to reach desired ends while satisfying laws in the problem environment.
Guideline 7: Communication of research	Design science research must be presented effectively, both to technology-oriented, as well as management-oriented audiences.

3.4.3.3. Procedures

Procedures refer to the processes utilised when conducting research. Peffers *et al*. (2006) designed a conceptual process which meets three objectives namely, it:

- provides a nominal process for conducting IS research, i.e. a generally accepted mechanism for IS research which can be used as a roadmap;
- builds on prior research; and
- is a mental or conceptual model which represents reality on a small scale.

The mental model illustrated in Figure 3.6 shows that the development of the artefact can be initiated through different entry points such as a problem, an objective, a design or development of an artefact, or through the context of a client. The illustration of the mental model furthermore shows that the nominal process requires knowledge of the context (business or organisation) that leads to inferences, knowledge about existing theory that informs objectives of a solution, knowledge on how to construct an artefact, knowledge of metrics and data analysis for the evaluation of the artefact, and disciplinary knowledge. The process includes the following activities:

Activity 1: Problem identification and motivation.

Activity 2: Define the objectives for a solution.

Activity 3: Design and development of the artefact.

Activity 4: Demonstration of the developed artefact.

Activity 5: Evaluation of the artefact.

Activity 6: Communication of the problem and its importance, the developed artefact and its utility and novelty as well as the description of the rigour and effectiveness of the solution.

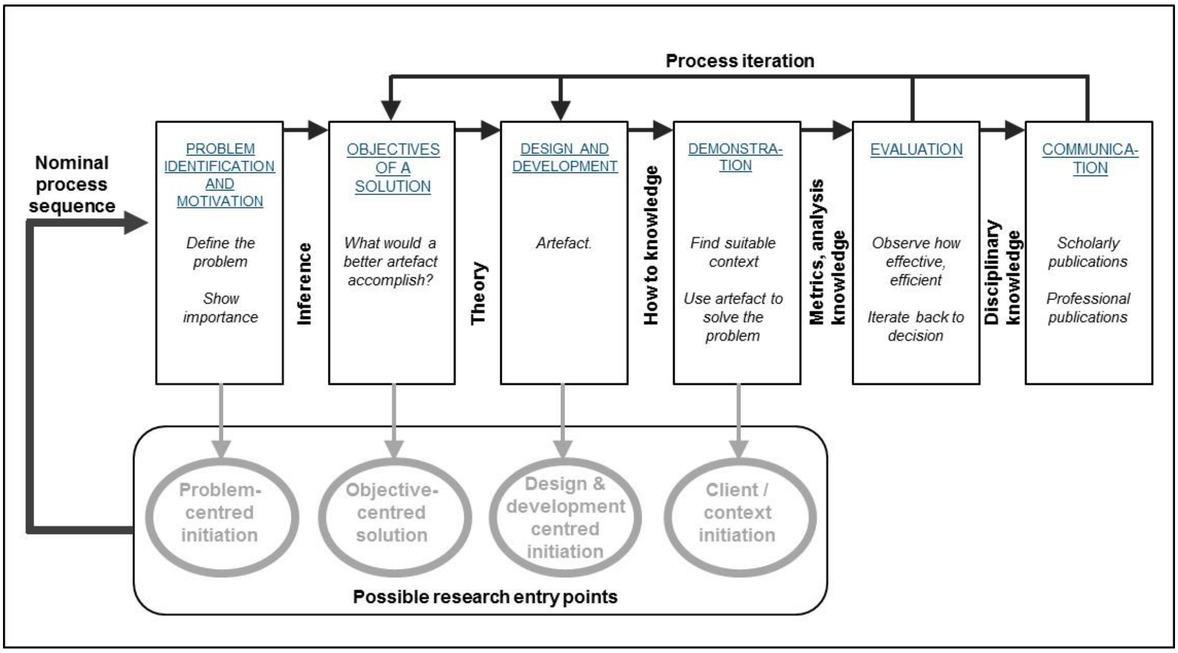


Figure 3.6. Design science research process model (Peffers *et al.*, 2006, p. 93).

3.4.4. Summary

By considering the three examples presented, the most applicable example for the TVET-MIS-EVAL methodology (artefact) is the DSRM, because the TVET-MIS-EVAL methodology will also be applied as a generalisation of a specific methodology in the IS success evaluation knowledge domain within the context of public TVET Colleges and will offer a solution to an understood organisational problem.

It is important to note that the overall study in which the artefact (TVET-MIS-EVAL methodology) is being developed is embedded in the design science paradigm and that the process through which the TVET-MIS-EVAL methodology is developed, as explained in Chapter 2, is informed by the design science research process model (DSRP model) developed by Peffers *et al*. (2006, p. 93). The conceptual framework of the TVET-MIS-EVAL methodology itself is informed by the design science research methodology (DSRM) presented by Peffers *et al*. (2008), which includes: principles, practices and rules, and procedures. Figure 3.7 depicts this conceptual relationship.

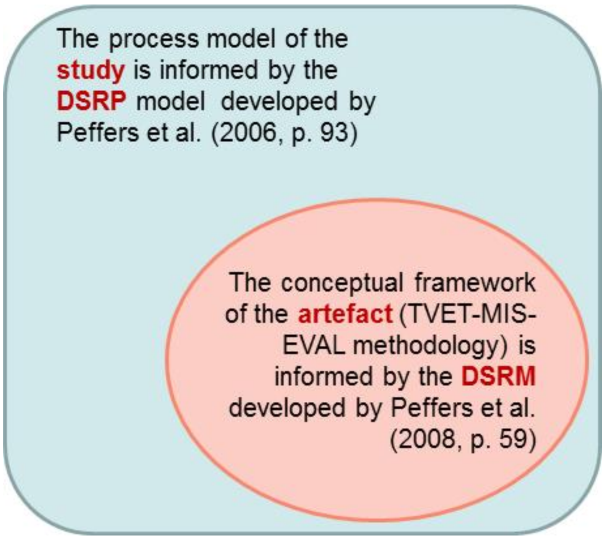


Figure 3.7. Illustration of the underpinning theory for the study and for the artefact.

3.5. Conclusion - Components of a methodology

This chapter investigated the objectives of a solution to the first sub-research question namely: *What are the components of a methodology*?

The literature review on theories and practices related to methods, methodologies and paradigms, as communicated in this chapter, provides insight into and awareness of the meaning and utilisation of the different terms and concepts.

The review found that a methodology consists of guidelines to solve a problem and it should include components such as phases, tasks, methods, techniques and tools (Irny & Rose, 2005) that should be enfolded in principles, practicing rules and procedures (Peffers *et al.*, 2008). It was also found that a paradigm encompasses two dimensions namely a *philosophical* dimension, which includes basic beliefs and assumptions about the world, and a *technical* dimension, which incorporates the methods and techniques adopted when conducting research. Thus, a methodology represents the philosophical underpinning of a paradigm, as well as the methods and how they are used are shaped by this methodology (McGregor & Murnane, 2010).

The literature review furthermore revealed that a methodology generally encompass the following four elements: it provides an opinion of what needs to be solved; it defines techniques on what has to be done and when it should be done; it advises on how to manage the quality of deliverables or products; and it provides a toolkit to facilitate the process (Robson, 1997). Since the TVET-MIS-EVAL methodology will also possess an evaluation component, it will require the integration of empirical evidence with standards and values in order to make judgements and to facilitate evaluative conclusions and decisions.

Table 3.4 depicts the conceptual framework of the components of a TVET-MIS-EVAL methodology based on the literature studied in this chapter. Specific tasks, methods, techniques and tools for success evaluation of MIS at public TVET Colleges will be investigated in Chapter 4.

Table 3.4. Conceptual framework of the components (phases) of the TVET-MIS-EVAL methodology as informed by the DSRM (Peffers *et al.*, 2008).

Phase	Objective
Phase A: Principles	Define the main principles of the TVET-MIS-EVAL methodology.
Phase B: Guidelines, practices and rules	Develop guidelines for the TVET-MIS-EVAL methodology by using the guidelines for design science research as point of departure.
Phase C: Procedures	Design a conceptual process model for conducting success evaluation of MISs deployed at public TVET Colleges that will satisfy the following objectives: it should be consistent with prior literature and it should provide a nominal process model.
Phase D: Toolkit	Models and methods for success evaluation of MIS at public TVET Colleges.
Phase E: Standards and values	Define standards and values based on the outcome during the evaluation of the artefact on the selected cases.

The following chapter will examine the objectives of a solution for the second research question namely: *What models exist to support the success evaluation of MISs at public TVET Colleges?*

CHAPTER 4. MODELS FOR THE EVALUATION OF MANAGEMENT INFORMATION SYSTEMS

4.1. Introduction

In Chapter 3 an investigation into the components required for the development of a methodology as an artefact was conducted. The chapter concluded with a conceptual framework for the TVET-MIS-EVAL methodology for the evaluation of management information systems (MIS) at public TVET Colleges in South Africa. The literature review described in this chapter focuses on the second sub-research question in support of the main research question of the study namely: *What models exist to support the evaluation of MISs at public TVET Colleges?* (cf. section 1.2.3.3). Hence, the information gathered and analysed in this chapter will provide theoretical impetus to the development of the components, *Phase C: Procedures* and *Phase D: Toolkit,* of the conceptual framework of the TVET-MIS-EVAL methodology, as proposed in Chapter 3 (cf. Table 3.4).

This chapter proceeds with section 4.2 situating the literature review within the design science research process (DSRP) model context, which was adopted for the study, as depicted in Figure 4.1. Thereafter the keywords used to scope the literature review (cf. Figure 4.2) and the results of the systematic literature review (cf. Table 4.1) are presented. Subsequent sections present information in the following order: section 4.3 provides background information on extant literature about the evaluation of information systems; section 4.4 explains key concepts in the knowledge domain of IS success evaluation and section 4.5 presents a synthesis of models with their underlying theories utilised to evaluate information systems. Thereafter, in section 4.6, information about extant models and methods for the evaluation of information systems found in the literature is presented. The motivation for the selected base model for *Phase C: Procedures* and *Phase D: Toolkit* of the TVET-MIS-EVAL methodology is presented in section 4.7. The selected model for inclusion in the TVET-MIS-EVAL methodology is provided in section 4.8. Section 4.9 provides a description of the constructs and effectiveness measures that will inform the development of instruments for *Phase C: Procedures* and *Phase D: Toolkit* of the TVET-MIS-EVAL methodology (cf. Chapter 3, Table 3.4). The data collection tools are provided in section 4.10. The chapter concludes in section 4.11 with a summary of the chapter.

4.2. Situation of the literature review

The investigation narrated in this chapter falls within Phase 3 of the research process of the study, as described in Chapter 2 section 2.5.3 namely: *define objectives of a solution,* which is informed by the second activity in the DSRP model (Peffers *et al.*, 2006) as depicted and shaded in Figure 4.1.

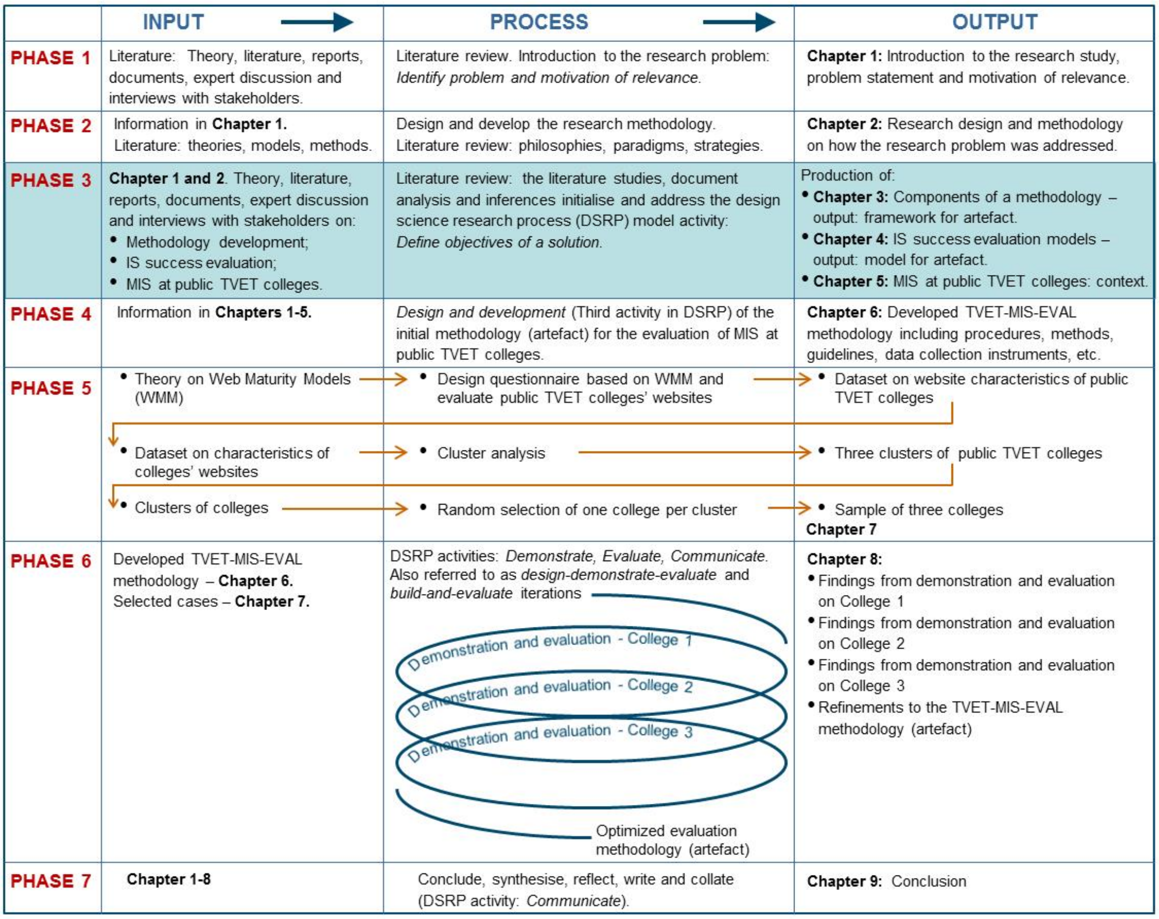


Figure 4.1. Research process of the study delineated by phases, inputs, activities and outputs, underpinned by the design science research process (DSRP) model (Peffers *et al.*, 2006, p. 93).

Figure 4.2 highlights the part of the systematic literature review relevant to this chapter. The framework for the systematic literature review of the study was introduced in section 1.3.1. As listed in Figure 4.2, the literature review for this chapter was initiated with keyword searches on: *Information Systems success evaluation models; Information Systems evaluation methods; Information Systems effectiveness; Information Systems efficiency; Information Systems models*.

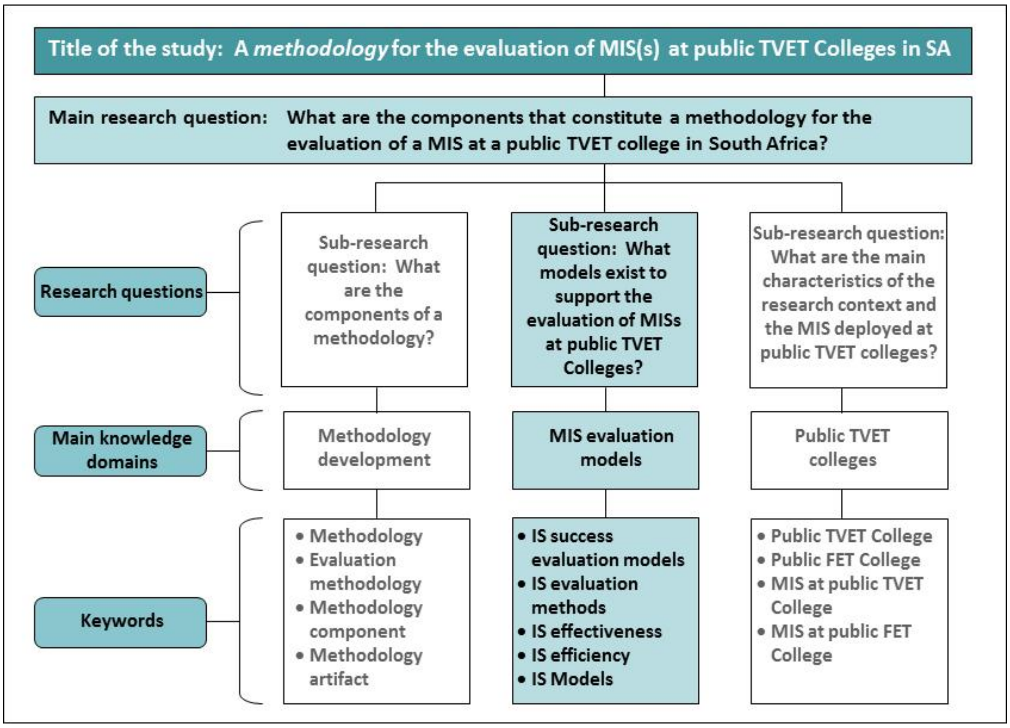


Figure 4.2. Literature review plan for MIS success models for the study.

Literature review techniques, as defined and explained in Table 1.1, were then utilised to explore the knowledge domain further. Table 4.1 provides information on the structured approach that was followed in conducting the systematic literature review for this chapter through which the initial sources were collected. Although the number of resources found on keyword searches were recorded in Table 4.1, not all were suitable for referencing. Resources for further scrutiny were selected based on the full titles and if the titles were deemed relevant a quick review of the abstract was done to evaluate the paper for inclusion.

The systematic process, through which literature sources were retrieved, made use of the ABI/INFORM™ complete database provided by ProQuest and the

Association of Computing Machinery (ACM) Digital Library. These databases were selected to ensure balanced coverage.

Table 4.1. Results of the systematic literature overview to indicate scope. Adapted from Levy and Ellis (2006), and Webster and Watson (2002).

Publication	**Search criteria**	**Results: (Number of related articles)**
ABI/INFORM™		
MIS Quarterly	Abstract [(information systems evaluation) OR (information systems success)]; full-text; peer reviewed; All dates.	35
MIS Quarterly	Any field [(MIS evaluation)]; full-text; peer reviewed; all dates.	250
MIS Quarterly	Any field [(Information systems evaluation)]; full-text; peer reviewed; all dates.	247
South African Journal of Information Management	Any field [(MIS OR Management Information System) AND (success evaluation)]; full-text; peer reviewed; 2010-2016.	22
Journal of Information Systems & Operations Management	Any field [(MIS OR Management Information System) AND (success evaluation)]; full-text; peer reviewed; 2010-2016.	29
Information Systems Research	Abstract [(information systems evaluation) OR (information systems success)]; full-text; peer reviewed; all dates.	6
Journal of Management Information Systems	Abstract [(information systems evaluation) OR (information systems success)]; full-text; peer reviewed; all dates.	42
Journal of Information Systems & Operations Management	Abstract [(information systems evaluation) OR (information systems success)]; full-text; peer reviewed; all dates.	1
International Journal of Information Management	Abstract [(information systems evaluation) OR (information systems success)]; full-text; peer reviewed; all dates.	13
International Journal of Management & Information Systems	Abstract [(information systems evaluation) OR (information systems success)]; full-text; peer reviewed; all dates.	3
ACM Digital Library	Abstract [(+IS +success +evaluation +models)]; full-text; peer reviewed; all dates.	554
ACM Digital Library	*Abstract [(+Information +systems +success +evaluation)];* Any field (MIS evaluation OR MIS success); full-text; peer reviewed; all dates.	231
Communications of the ACM	*Abstract (+Information +systems +success +evaluation);* Any field (MIS evaluation OR MIS success); full-text; peer reviewed; all dates.	6

The ABI/INFORM™ database comprises of ABI/INFORM Global, ABI/INFORM Trade and Industry, and ABI/INFORM Dateline. The databases feature thousands of full-text journals, dissertations, working papers, key newspapers, conference proceedings, technical magazines, newsletters and books. Although literature searches initially started with high level main keywords, more searches on keywords and references found in the initially collected sources were conducted afterwards in a snowballing manner.

4.3. Background to Information Systems evaluation

The MIS knowledge domain is about studies of people, technology and organisations and the interrelationships amongst them. An information system is defined as "a combination of hardware, software, infrastructure and trained personnel organised to facilitate planning, control, coordination, and decision making in an organisation" (WebFinance, 2015). A MIS is a computer-based system which incorporates databases that consist of financial, operational and administrative data. It also includes software tools and programmes for the production of regular reports about operations of different business units and for every level of management in the organisation. The data and information are utilised by managers for decision-making purposes thus to organise, plan, evaluate performance and manage units in the organisation. One of the main purposes of a MIS is to measure progress against planned goals. Hence, continued MIS efficiency includes the development of innovative concepts, methods and tools to contribute to more effective and efficient business practices and to solve problems within an organisation. MISs provide information processing support to management activities. MISs are of interest to practitioners, theorists and researchers (Kriebel, 1970; Platiša & Balaban, 2009).

MISs are essential parts of day-to-day business operations and since they extensively contribute to the health and development of an organisation it is important to evaluate their performance to ensure continuous compliance with business needs and goals. The performance of a MIS should be evaluated in the context in which it is operated including hardware and technology utilised; functional computer networks available; information communication technology (ICT) available; availability of internet access; data processes and human resources available. The main purpose for the evaluation of the functionality performance of a MIS is the upgrading and improvement of the quality and maintenance of the system (Kriebel, 1970; DeLone & McLean, 2004; Platiša & Balaban, 2009; Dwivedi *et al.*, 2015).

One of the most prominent streams in IS research is the success and failure of information systems. Clarifications as to why some ISs fulfil their expectations whilst others fail to meet expectations are complex and multi-factorial. The terms *failure* and *success* in the IS discipline have been extensively researched but they are still difficult to define (Dwivedi *et al.*, 2015). The following section presents a summary of the debate in the existing literature on the most common justification for IS evaluation outcomes (success or failure).

4.3.1. Information systems success

IS success is one of the oldest research concepts in IS research and gained extensive momentum after the ICIS (International Conference on Information Systems) conference in 1980 at which the questions about what is and what determines IS success were raised (Petter, DeLone & McLean, 2013). In the decades that followed surveys of computer managers, conducted by academics and consultants, listed the evaluation of IS success as one of the top issues of concern (Grindley, 1991; Al-Adaileh, 2009). Davis (1985, p. 8) argues that "to a great extent, MIS research is concerned with the development of theories and techniques that permit practitioners to better measure and predict how the decisions under their control affect MIS success". Many academics, hardware and software vendors and consultants including: Gallagher (1974), Ahituv (1980), Bailey and Pearson (1983), DeLone and McLean (1992), Seddon and Kiew (1996) , Myers *et al*. (1997), Bresnick and Schaeffer (1999), Chang and King (2000), Petter *et al*. (2008), Petter *et al*. (2013), Dwivedi *et al*. (2015), published prescriptions on how to solve the problem of IS success evaluation. At the same time, a plethora of literature accumulated which included reviews of practices, reviews of the methods formulated, theoretical and pragmatic insights into the problem, and case studies for students and practitioners (Irani & Love, 2008b).

DeLone and McLean (1992) reviewed almost 200 research papers published between 1981 and 1987 in an investigation to ascertain the dependent variable in IS success. The authors found that IS success is a multidimensional construct and they developed and proposed the D&M IS success model through their findings (cf. section 4.6.9). The model consists of six interrelated variables, or components, of IS success namely: System Quality, Information Quality, Use, User Satisfaction, Individual Impact and Organisational Impact (DeLone & McLean, 1992). The authors challenged information systems researchers to conduct empirical research to validate or invalidate the model and to suggest new components or dimensions of the model.

In an attempt to further the understanding of the D&M IS success model, a number of studies have been conducted attempting to validate or the entire model or parts thereof (Sabherwal, Jeyaraj & Chowa, 2006). For example, Seddon and Kiew (1996) examined the relationships among four of the constructs and found significant support. Seddon (1997) furthermore suggests modifications to the D&M IS success model based on theoretical considerations and named it the Re-specified D&M IS success model. Seddon's model includes three types of constructs: measures of systems and information quality, system use as behaviour, and measures of net benefits from the use of the system (cf. section 4.6.12). Rai, Lang and Welker (2002) compared the original D&M IS success model (1992) to the Re-specified D&M IS success model created by Seddon (1997) and found that the original model stood up reasonably well to the validation attempt and outperformed the Seddon model. Rai *et al*. (2002) focused on five constructs: system quality, information quality, perceived usefulness, user satisfaction and system use.

Sedera *et al*. (2004) also tested several success models, including the D&M and Seddon models, against empirical data and determined that the D&M Model provided the best fit for measuring enterprise systems success (Petter *et al*., 2008). McGill, Hobbs and Klobas (2003, p. 24) examined all concepts of the D&M IS success model, but found four paths in the original IS success model to be insignificant (the relationships between *system quality* and *use*, *information* *quality* and *use*, *intended use* and *individual impact*, and between *individual impact* and *organisational impact*).

Ten years after the original D&M IS success model had been presented, DeLone and McLean conducted a follow-up study to update the original model. The authors found substantial empirical support for the D&M IS success model. The research studies either tested the model directly, or compared the model to other success-model designs. The review suggested changes to the original model - another dimension: *Service Quality* was added to the original model; the dimension: *Use* was divided into *Use* and *Intention to Use*; and the two dimensions *Individual Impact* and *Organisational Impact* were collapsed into the dimension *Net Benefits* (DeLone & McLean, 2003) (cf. section 4.6.10).

The literature furthermore provides evidence of models where the D&M IS success model has been combined with other models such as the Technology Acceptance Model (TAM) (cf. section 4.6.1) and the Unified Theory of Acceptance and Use of Technology (UTAUT) (cf. section 4.6.3) models (Mardiana, Tjakraatmadja & Aprianingsih, 2015), the User Satisfaction and the Technology Acceptance models (Wixom & Todd, 2005) (cf. section 4.6.7) and a combination of the original D&M IS success model, the Updated D&M IS success model and the End User Computing Satisfaction Model (Visser, van Biljon & Herselman, 2013) (cf. section 4.6.14).

In summary, the literature revealed that the most frequently used models to evaluate IS success are:

- DeLone and McLean IS success model (D&M IS success model) including the Original and Updated versions (DeLone & McLean, 1992, 2003);
- Technology Acceptance Model (TAM) (Davis, 1985, 1993);
- Task-Technology Fit model (TTF) (Goodhue & Thompson, 1995); and
- End User Computing Satisfaction model (EUCS) (Doll & Torkzadeh, 1988).

The most commonly used theories on which the IS success models are based are:

- Theory of reasoned action (Fishbein & Ajzen, 1975);
- Theory of planned behaviour (Ajzen, 1985);
- Theory of beliefs and attitudes (Bandura, 1977);
- Behavioural theory of the firm (Cyert & March, 1963); and
- Mathematical theory of communications (Shannon & Weaver, 1949).

Sections 4.5 and 4.6 provide more detailed information on the underlying theories and models utilised for IS success evaluation.

The next section presents information on studies that were conducted by focusing on the failure of information systems.

4.3.2. Information systems failure

Although the failure of IS projects is not within the scope of the literature study for this chapter, brief notes on IS failure is provided to accentuate the difference between IS failure and IS success research streams in IS research.

Many studies have been conducted with the focus on investigating information systems failure (Dwivedi *et al.*, 2015). Ewusi-Mensah (2003) states that almost one-third of software development projects either fail or development is discontinued on different completion stages mainly because of cost overspending, delays and reduced functionality. IS failure can thus be as a result of the implemented system not meeting the user expectations or the inability of developers to produce a functioning system.

Earlier research in IS failure emphasised the importance of contributing factors categorised as correspondence, process, interaction and termination factors (Lyytinen & Hirschheim, 1988; Sauer, 1993). In more recent years organisations have started to investigate why IS projects fail by conducting retrospective studies called *project post-mortems* or *post-implementation reviews*. Nelson (2007) aggregated 99 retrospective studies that were conducted in 74 organisations over a period of seven years and reported on the most common mistakes causing IS projects to fail. Some of the main causes were recorded as: contractor failure; poor requirements determination; ineffective stakeholder management; research-oriented development; poor time estimation and insufficient risk management (Nelson, 2007). Further in-depth investigation revealed that IS failure is seldom a result of chance but rooted in one or a series of mistakes by project managers (Nelson, 2007). McConnell (1996, p. 40) provides the following "classic mistakes" grouped into four categories: people, process, product and technology related mistakes. A list of the "classic mistakes" by category is provided in Table 4.2.

Table 4.2. Classic mistakes contributing to IS failure (McConnell, 1996, p. 49).

People related mistakes	Process-related mistakes	Product-related mistakes	Technology-related mistakes
1. Undermined motivation.	14. Overly optimistic schedules.	28. Requirements gold-plating.	33. Silver-bullet syndrome.
2. Weak personnel.	15. Insufficient risk management.	29. Feature creep.	34. Overestimated savings from new tools or methods.
3. Uncontrolled problem employees.	16. Contractor failure.	30. Developer gold-plating.	35. Switching tools in the middle of a project.
4. Heroics (can-do attitudes).	17. Insufficient planning.	31. Push-me, pull-me negotiation.	36. Lack of automated source-code control.
5. Adding people to a late project.	18. Abandonment of planning under pressure.	32. Research-oriented development.	
6. Noisy, crowded offices.	19. Wasted time during the fuzzy front end.		
7. Friction between developers and customers.	20. Short-changed upstream activities.		
8. Unrealistic expectations.	21. Inadequate design.		
9. Lack of effective project sponsorship.	22. Short-changed quality assurance.		
10. Lack of stakeholder buy-in.	23. Insufficient management controls.		
11. Lack of user input.	24. Premature or overly frequent convergence.		
12. Politics placed over substance.	25. Omitting necessary tasks from estimates.		
13. Wishful thinking.	26. Planning to catch		

People related mistakes	Process-related mistakes	Product-related mistakes	Technology-related mistakes
	up later.		
	27. Code-like-hell programming.		

The following section presents definitions or descriptions of key concepts utilised in the IS success research field.

4.4. Key concepts utilised in IS success evaluation

The most commonly used concepts or building blocks of the different IS success models as found in the literature, are listed and defined in Table 4.3 below.

Table 4.3. Information systems success constructs.

Construct	Definition/Description
Information system	In IS success the information system is either some aspect of an application of information technology (IT), one software application, a group of applications or an application of one type of IT (Seddon, 1997).
System quality	The quality of a system in terms of attributes such as ease of use, system flexibility, system reliability and ease of learning, as well as system features of intuitiveness, sophistication, flexibility and response times (Petter, Delone & Mclean, 2008; Petter, DeLone & McLean, 2013). Wixom and Todd (2005) suggest the following attributes for system quality: accessibility, timeliness, language, flexibility, integration and efficiency.
Information quality	Information quality relates to the preferred characteristics of systems' outputs (content, reports, dashboards), which are used in management reports and web pages: for example, accuracy, precision, reliability, format, volume, relevance, understandability, conciseness, completeness, currency, timeliness and usability (Wixom & Todd, 2005; Petter, Delone & Mclean, 2008; Petter, DeLone & McLean, 2013).
Service quality	Service quality refers to the quality of service or support that system users receive from the IS department and the IT support personnel in general, or for a specific IS, including aspects such as communication, relationships, attitude of support staff, vendor support, responsiveness, accuracy, reliability, technical competence and empathy of the staff (Petter, Delone & Mclean, 2008; Petter, DeLone & McLean, 2013). SERVQUAL is a tool in the form of a questionnaire that was adapted from the field of marketing and is a popular instrument for measuring the service quality of IS (Pitt, Watson & Kavan, 1995; Jiang, Klein & Carr, 2002). Landrum, Prybutok, Zhang and Peak (2009) note that service

Construct	Definition/Description
	quality can be measured as the gap between the service that customers expect and the performance which they perceive they have received.
System use	System use is the degree and manner in which staff and customers utilise the capabilities of an information system. This includes characteristics such as amount of use, frequency of use, nature of use, appropriateness of use, extent of use and purpose of use (Petter, Delone & Mclean, 2008; Petter, DeLone & McLean, 2013).
User satisfaction	User satisfaction refers to users' level of satisfaction with the IS including reports, websites and support services. Petter *et al*. (2008) states that the most widely used multi-attribute instrument for measuring user information satisfaction can be found in Ives, Olson and Baroudi (1983). According to Freeze (2010) user satisfaction is a measure of the successful interaction between an information system and its users. It is also defined as the extent to which users believe that the information system meets their needs (Ives, Olson & Baroudi, 1983). If a system meets the requirements of the users, their satisfaction with that information system will be enhanced (Bharati, 2003).
Net benefits	The term net benefits refers to the extent to which information systems are contributing to the success of individuals, groups, organisations, industries and nations; for example, improved decision making, improved productivity, increased sales, reduced costs, improved profits and market efficiency, as well as increased consumer welfare, job creation and economic development (Petter, DeLone & McLean, 2013). Hence, production economics has been used to measure the positive impact of IT investments on firm-level productivity (Brynjolfsson, Hitt & Yang, 2002; Petter, Delone & Mclean, 2008). The term net benefits include the terms organisational impact and individual impact. Organisational impact represents the firm-level benefits received by an organisation because of IS applications (Gorla, Somers & Wong, 2010), while individual impact is a measure of the extent to which the information system has influenced the capabilities and effectiveness, on behalf of the organisation, of key users (Gable, Sedara & Chan, 2008).
Determinants of IS success: Task	Task characteristics: task compatibility and task difficulty (Petter, DeLone & McLean, 2013).
Determinants of IS success: Structure	Structure: project and organisational characteristics such as user involvement, relationship with developers, domain expert knowledge, management support, extrinsic motivation, management processes, organisational competence, IT infrastructure (Petter, DeLone & McLean, 2013).
Determinants of IS success: People	People: user and social characteristics such as attitudes toward technology, enjoyment, trust, self-efficacy, user expectations, technology experience, organisational role (Petter, DeLone & McLean, 2013).

Construct	Definition/Description
IS success: Technology	Includes the dimensions: system quality, information quality, service quality, intention to use, user satisfaction and net benefits.
Usefulness	Includes two attributes: usefulness and relevance (Wixom & Todd, 2005).
Ease of use	Includes attributes: user friendly and easy to use (Wixom & Todd, 2005).
Outcome expectations	Outcome expectations can be described by incorporating attributes such as: expectations, understanding of systems, confidence in the system, feelings of participation, feelings of control, degree of training and job effects (Wixom & Todd, 2005).
Organisational factors	Organisational factors include factors such as: top management involvement, organisational competition with electronic data processing (EDP), priorities determination, change-back method, error recovery, security of data, documentation and organisational position of EDP (Wixom & Todd, 2005).

The concepts or constructs and their definitions listed in Table 4.3 emphasise the complexity and multidimensionality of the construct: *IS success evaluation* and also provides the underlying effectiveness measures of each supporting construct. The following section presents information on theories that underpin IS success models.

4.5. Theories underpinning IS success models

The most commonly utilised models to evaluate IS success and prominent theories have been mentioned in section 4.3.1. Table 4.4 depicts an updated version of the synthesis of IS success models with their underlying theories as presented by Visser *et al*. (2012; 2013). It is evident from Table 4.4 that researchers in the field of IS success have conducted empirical studies in which IS success were evaluated based on portions, combinations or extensions of the most common IS success models. The synthesis of models and their underlying theories, as depicted in Table 4.4, is presented to show that various models for evaluating IS success exist.

Table 4.4. An extension of the synthesised overview of IS success evaluation models and their underlying theoretical frameworks, as provided by Visser *et al*. (2012, p. 385, 2013, p. 2).

Year (theory developed)	Theory developed by:	Theory	Name of the model based on theory	Model abbreviation	Model developed / extended by:	Year (Model developed)
1934	LaPiere, R.T. – Evidence in the literature of the link between attitudes and behaviours (LaPiere, 1934a, 1934b)	Led to the formulation of the theories of reasoned action and planned behaviour				
1949	Shannon and Weaver (Shannon & Weaver, 1949)	Mathematical Theory of Communications	Expanded Shannon and Weaver's theory by extending the 'effectiveness level' into three categories	Expanded Mathematical Theory of Communications	Mason, R.O.	1978
1963	Cyert and March (Cyert & March, 1963)	Behavioural Theory of the Firm	Development of a Tool for Measuring and Analysing Computer User Satisfaction (Bailey & Pearson, 1983)	CUS	Bailey, J.E. Pearson, S.W.	1983
			The Measurement of End-User Computing Satisfaction (Doll & Torkzadeh, 1988)	EUCS	Doll, W.J. Torkzadeh, G.	1988
		Integration of the two concept theories 'Beliefs and attitudes about the system' and 'Beliefs and attitudes about using the system'	Integration of the User satisfaction literature and the Technology Acceptance Model (Wixom & Todd, 2005)	Integration of User Satisfaction (US) and TAM	Wixom, B.H. Todd, P.A.	2005
1975	Fishbein and Ajzen (Fishbein & Ajzen, 1975)	Theory of Reasoned Action, Theory of Planned Behaviour	Technology Acceptance Model (Davis, 1985, p. 24)	TAM	Davis, F.D.	1985
			Technology Acceptance Model (Davis, Bagozzi & Warshaw, 1989)	TAM	Davis, F.D., Bagozzi, R.P., Warshaw, P.R.	1989
			Technology Acceptance Model 2 (Venkatesh & Davis, 2000)	TAM2	Venkatesh, V., Davis, F.D.	2000

Table 4.4. An extension of the synthesised overview of IS success evaluation models and their underlying theoretical frameworks, as provided by Visser *et al*. (2012, p. 385, 2013, p. 2).

Year (theory developed)	Theory developed by:	Theory	Name of the model based on theory	Model abbreviation	Model developed / extended by:	Year (Model developed)
			Unified Theory of Acceptance and Use of Technology (Venkatesh *et al.*, 2003)	UTAUT	Venkatesh, V. Morris, M.G. Davis, F.D. Davis, G.B.	2003
			Technology Acceptance Model 3 (Venkatesh & Bala, 2008)	TAM3	Venkatesh, V. Bala, H.	2008
			Task Technology Fit Model (Goodhue & Thompson, 1995)	TTF Model	Goodhue, D.L. Thompson, R.L.	1995
			TAM/TTF Model with Computer Self-Efficacy (Dishaw, Strong & Brandy, 2002)	Combined TAM/TTF Model	Dishaw, M.T. Strong, D.M. Bandy, D.B.	2002
			A Two-Stage Theoretical Model of Cognition Change (Bhattacherjee & Premkumar, 2004, p. 234)	A Two-Stage Theoretical Model of Cognition Change	Bhattacherjee, A. Premkumar, G.	2004
			Extended Unified Theory of Acceptance and Use of Technology (Venkatesh, Thong & Xu, 2012)	UTAUT2	Venkatesh, V., Thong, J.Y.L., Xu, X.	2012
1978	Mason (Mason, 1978)	Expanded Mathematical Theory of Communications	DeLone and McLean IS Success Model (DeLone & McLean, 1992)	D&M IS Success Model	DeLone, W.H. McLean, E.R.	1992
			Extension of the DeLone and McLean IS Success Model combined with the Technology Acceptance Model (Seddon & Kiew, 1996)	Extended D&M IS Success Model combined with TAM	Seddon, P.B. Kiew, M. Y.	1996
			Respecification and extension of the DeLone and McLean Model of IS Success (Seddon, 1997)	Partial behaviour model of IS Use	Seddon, P. B.	1997

Table 4.4. An extension of the synthesised overview of IS success evaluation models and their underlying theoretical frameworks, as provided by Visser *et al*. (2012, p. 385, 2013, p. 2).

Year (theory developed)	Theory developed by:	Theory	Name of the model based on theory	Model abbreviation	Model developed / extended by:	Year (Model developed)
			Updated DeLone and McLean IS Success Model (DeLone & McLean, 2003)	Updated D&M IS Success Model	DeLone, W.H. McLean, E.R.	2003
			Management Information Systems Success Evaluation Model (Visser, van Biljon & Herselman, 2013, p. 7) combines the EUCS and D&M original and updated models	SA-FETMIS Success Model	Visser, M. Van Biljon, J. Herselman, M.	2013
			DeLone and McLean model with technology acceptance and unified theory of acceptance and use of technology integration (Mardiana, Tjakraatmadja & Aprianingsih, 2015, p. 180)	The Extended D&M model	Mardiana, S. Tjakraatmadja, J.H. Aprianingsih, A.	2015

The question now remains: which model, extension, or combination will be suitable for inclusion in *Phase C: Procedures* and *Phase D: Toolkit* of the TVET-MIS-EVAL methodology (cf. section 3.5, Table 3.4)? In order to make a decision in this regard, it will be necessary to investigate the models in more detail. Section 4.6 thus describes selected IS success models in more detail to establish the suitability for inclusion in the TVET-MIS-EVAL methodology.

4.6. IS success models

A brief description of the most frequently used and cited IS success evaluation models are presented in this section. The existing models have been compared and reviewed for suitability for inclusion in the TVET-MIS-EVAL methodology and their applicability on public TVET Colleges. A motivation for the selected base model is provided in section 4.7 and the selected model for inclusion in the TVET-MIS-EVAL methodology is given in section 4.8. In section 4.9, the various constructs and effectiveness measures found in the literature are considered for suitability to fit the selected IS success model. The final proposed set of effectiveness measures is provided in section 4.10. Section 4.11 concludes the chapter with a summary of findings.

4.6.1. Technology Acceptance Model (TAM)

Davis (1985, p. 24) proposed the TAM as part of his doctoral studies. The TAM is one of the most influential extensions of Fishbein and Ajzen's (1975) theory of reasoned action in the literature. TAM replaces many of the theory of reasoned action's attitude measures with two technology acceptance measures, namely *ease of use* and *usefulness*. Both the theory of reasoned action and the TAM have strong behavioural elements that assume that when a person forms an intention to act, that he/she will be free to act without limitation. In the real world, however, there are many constraints that will limit the freedom to act (Bagozzi & Warshaw, 1992). The conceptual model of the TAM compared to the stages of the theory of reasoned action is given in Figure 4.3.

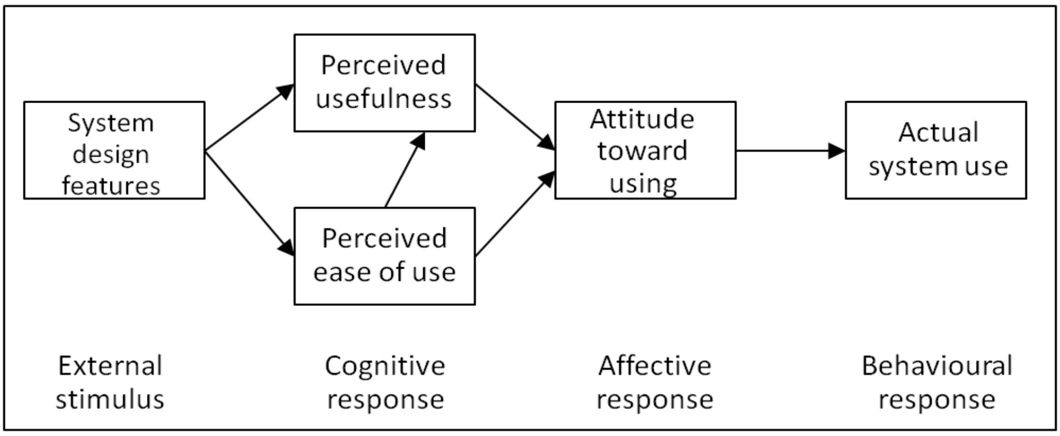


Figure 4.3. The TAM conceptual model (Davis, 1993, p. 476).

The TAM is an information systems model that represents the way in which users come to accept and use a technology (Davis, 1989). The model suggests that a number of factors influence a person's decision about how and when he/she will use a new technology when he/she is presented with it, in particular:

- Perceived usefulness – this was defined by Davis as "the degree to which a person believes that using a particular system would enhance his or her job performance" (Davis, 1989, p. 320).
- Perceived ease-of-use – this was defined by Davis as "the degree to which a person believes that using a particular system would be free from effort" (Davis, 1989, p. 320).

As depicted in the conceptual model in Figure 4.3, the TAM is mainly used to explain the impact of *system characteristics* and *end-user behaviour* on the *actual system use* (Davis, 1993).

Apart from IS success evaluation, the TAM is a well-respected model of IT adoption and operation that has been designed to explain computer usage within the context of information technology diffusion literature (Al-Adaileh, 2009). The terms IT/IS *adoption, acceptance* and *diffusion* are often used interchangeably by IT/IS researchers. Williams, Dwivedi, Lal and Schwarz (2009) found that *adoption* is preferred over the other two terms.

According to Petter *et al*. (2008), *acceptance* is not equivalent to success, although acceptance of an information system is a necessary precondition to success.

4.6.2. Theoretical extension of Technology Acceptance Model (TAM2)

The TAM has been continuously studied and expanded. The first major theoretical extension, TAM2, was developed by Venkatesh and Davis (2000) and is illustrated in Figure 4.4.

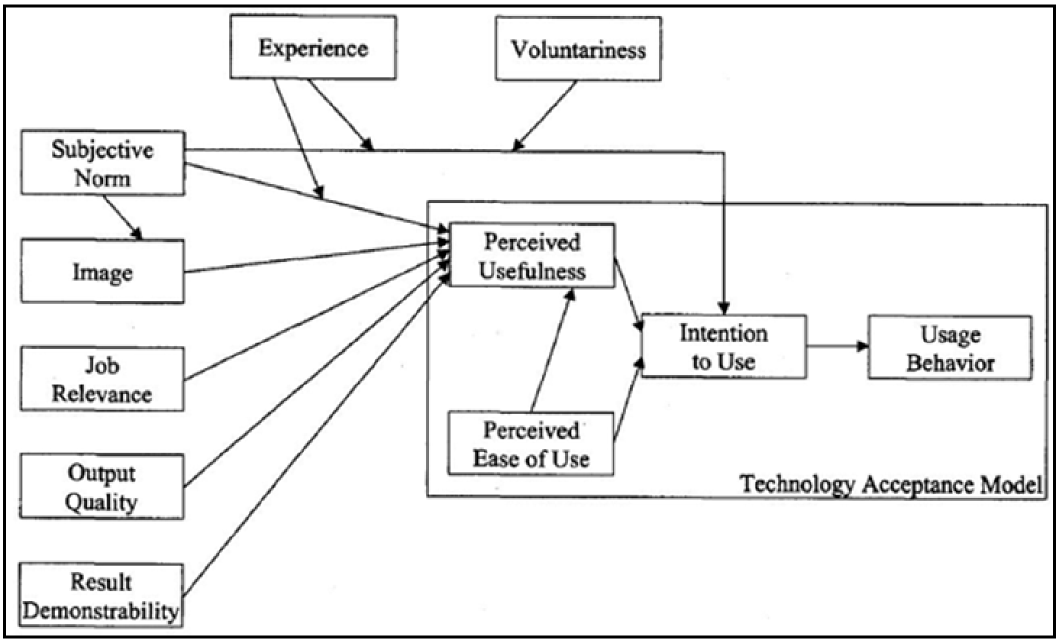


Figure 4.4. The TAM2 conceptual model (Venkatesh & Davis, 2000).

The difference between TAM and TAM2 lies in the factors that influence the user's perception of the usefulness of the technology. In TAM it is proposed that system design features influence perceived usefulness, while in TAM2 perceived usefulness and usage intentions are explained in terms of social influence and cognitive instrumental processes. It was found that both social influence processes (subjective norm, voluntariness and image) and cognitive instrumental processes (job relevance, output quality, result demonstrability and perceived ease of use) significantly influence user acceptance (Venkatesh & Davis, 2000).

The second major upgrade of TAM was the Unified Theory of Acceptance and Use of Technology (UTAUT) (Venkatesh *et al.*, 2003), as illustrated in Figure 4.5.

4.6.3. Unified Theory of Acceptance and Use of Technology (UTAUT)

The UTAUT model was the outcome of the revision and integration of eight different competing technology acceptance models. As stated by the authors, the eight models reviewed were the theory of reasoned action, the technology acceptance model, a motivational model, the theory of planned behaviour, a model combining the technology acceptance model and the theory of planned behaviour, a model of PC utilisation, innovation diffusion theory and social cognitive theory (Venkatesh *et al.*, 2003). It has been claimed by the authors that the UTAUT

> …provides a useful tool for managers needing to assess the likelihood of success for new technology introductions and helps them understand the drivers of acceptance in order to proactively design interventions (including training, marketing, etc.) targeted at populations of users that may be less inclined to adopt and use new systems (Venkatesh *et al.*, 2003, pp. 425–426).

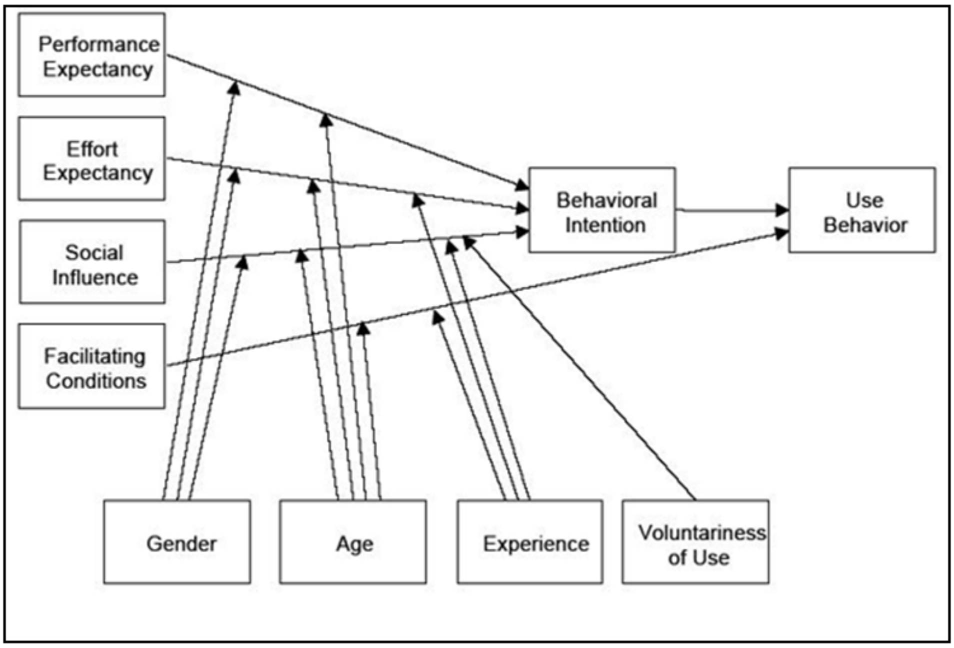


Figure 4.5. The UTAUT conceptual model (Venkatesh *et al.*, 2003, p. 447).

Lee, Rhee and Dunham (2009) examined the roles users' individual and organisational characteristics play in technology acceptance. It was observed that the perceived ease of use of an IT system was influenced by work group characteristics and attitude toward change. This implies that organisations can benefit by providing supervisory support and enhancing relations among colleagues to facilitate the use of an IT system. It also implies that people who like and enjoy organisational change will be more likely to accept new technology.

4.6.4. Further extension of Technology Acceptance Model (TAM3)

Venkatesh and Bala (2008) proposed a further extension of the TAM by suggesting TAM3 (Figure 4.7). TAM3 was developed from a theoretical framework (Figure 4.6) based on a synthesis of prior research on TAM. It addresses technology acceptance from an organisational point of view by considering the issue of how managers make informed decisions about interventions that can lead to greater acceptance and effective utilisation of IT. The authors drew from the body of research on TAM, particularly the work on the determinants of perceived usefulness (TAM2) and perceived ease of use, and developed an integrated model of the determinants of individual level IT adoption and use (Venkatesh & Bala, 2008).

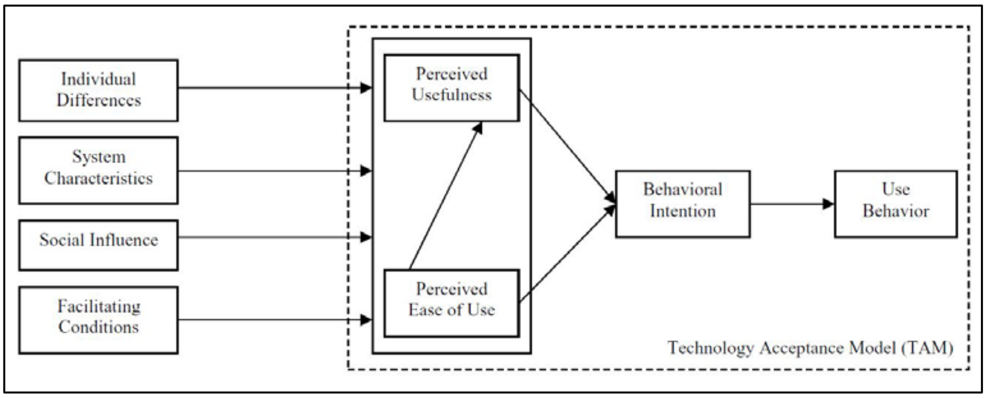


Figure 4.6. Theoretical model based on prior research on TAM (Venkatesh & Bala, 2008, p. 276).

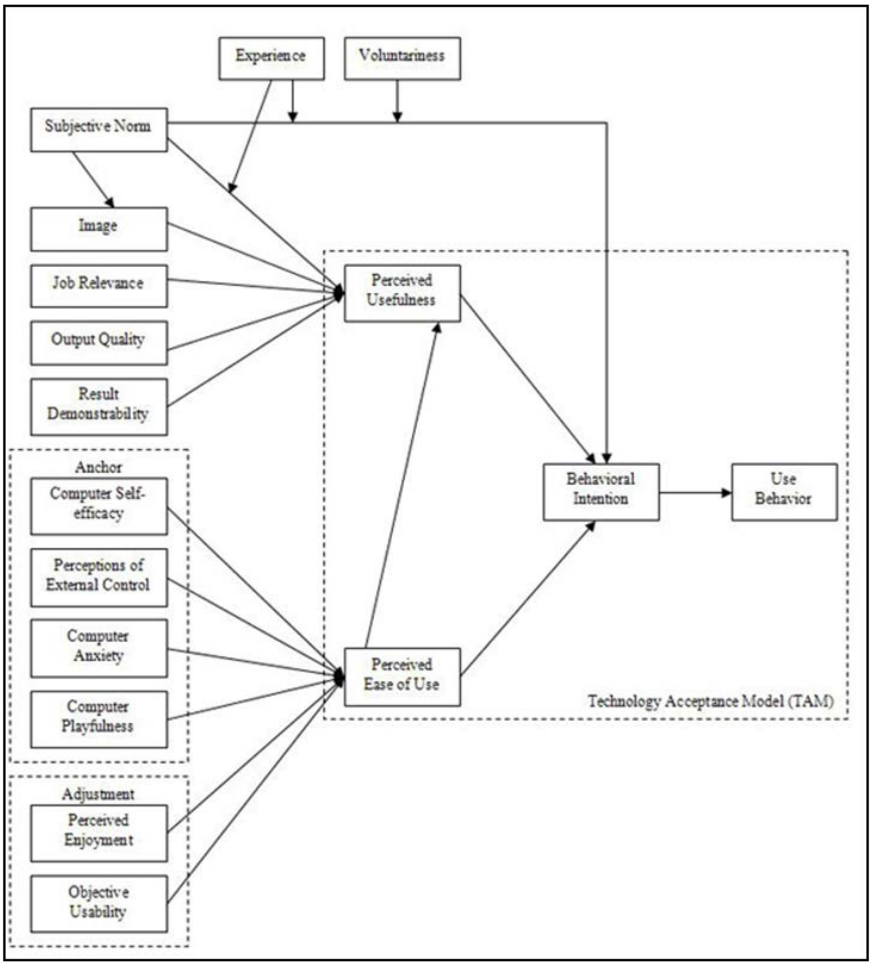


Figure 4.7. The TAM3 conceptual model (Venkatesh & Bala, 2008, p. 280).

4.6.5. Extended Unified Theory of Acceptance and Use of Technology (UTAUT2)

Venkatesh, Thong and Xu (2012) extended the UTAUT by studying acceptance and use of technology in a consumer context. The authors suggested that UTAUT2 incorporates three constructs into UTAUT: hedonic motivation, price value and habit (cf. Figure 4.8). They furthermore theorised that individual differences namely: age, gender and experience are moderating the effects of these constructs on behavioural intention and technology use. Compared to UTAUT, the extensions proposed in UTAUT2 produced a substantial improvement in the variance explained in behavioural intention and technology use.

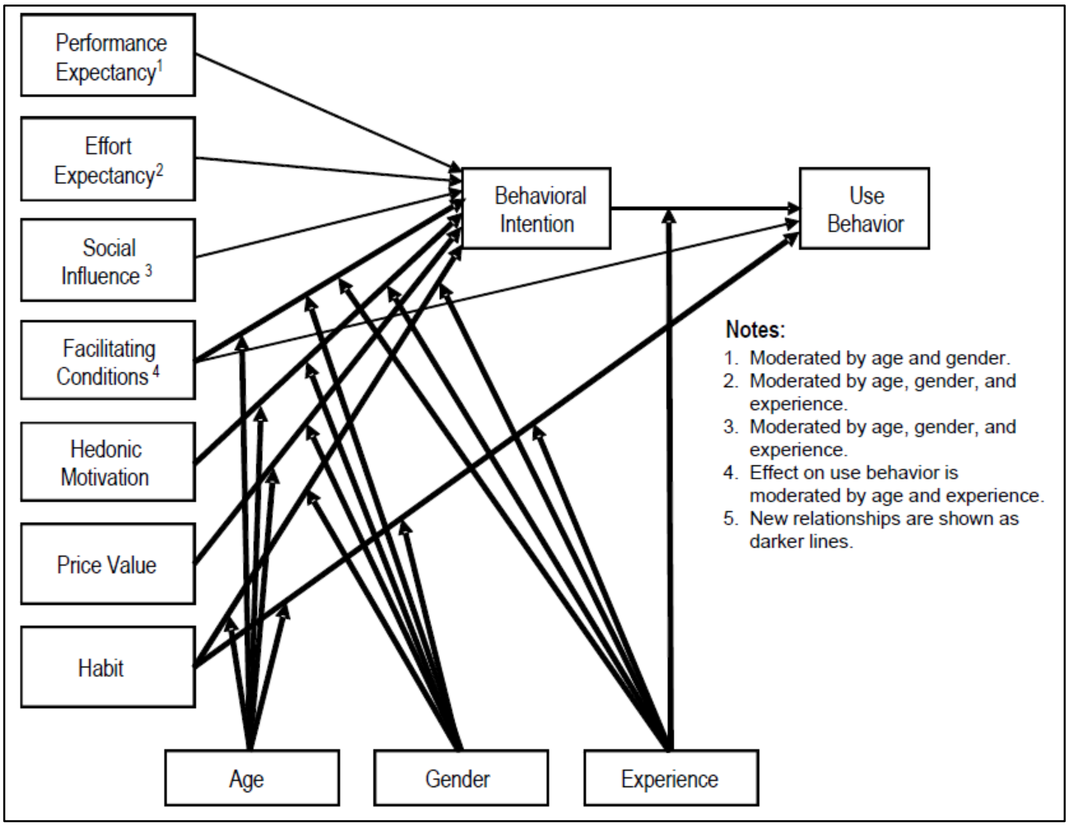
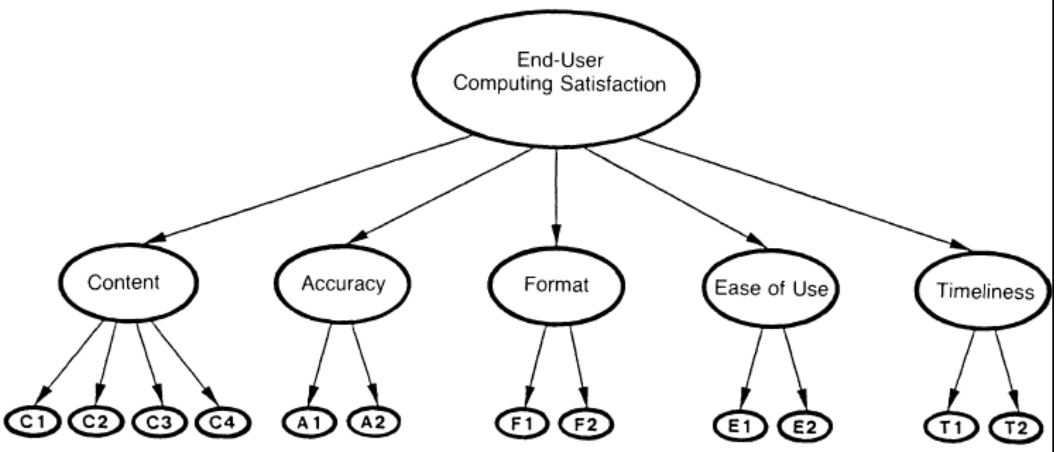


Figure 4.8. The UTAUT2 model (Venkatesh, Thong & Xu, 2012, p. 160).

4.6.6. End-User Computing Satisfaction Model (EUCS)

Doll and Torkzadeh (1988) carried out research on end-user computing satisfaction by contrasting traditional versus end-user computing environments and reported on the development of an instrument which merges ease of use and information product items to measure the satisfaction of users who directly interact with the computer for a specific application. The researchers started off with a 40 item instrument and conducted a survey of 618 end users. After doing a factor analysis they modified the instrument. The results suggested a 12 item instrument that measures five components of end-user satisfaction: *content*, *accuracy*, *format*, *ease of use* and *timeliness*. Evidence of the instrument's discriminant validity has been presented, while reliability and validity were assessed by nature and type of application.

Figure 4.9 provides an illustration of the model, a list of the questions used and the identified underlying factors or components of end-user computing satisfaction obtained by factor analysis (Content, Accuracy, Format, Ease of use, and Timeliness).



CONTENT
C1: Does the system provide the precise information you need?
C2: Does the information content meet your needs?
C3: Does the system provide reports that seem to be just about exactly what you need?
C4: Does the system provide sufficient information?

ACCURACY
A1: Is the system accurate?
A2: Are you satisified with the accuracy of the system?

FORMAT
F1: Do you think the output is presented in a useful format?
F2: Is the information clear?

EASE OF USE
E1: Is the system user friendly?
E2: Is the system easy to use?

TIMELINESS
T1: Do you get the information you need in time?
T2: Does the system provide up-to-date information?

Figure 4.9. A Model for measuring End-user Computing Satisfaction (Doll & Torkzadeh, 1988, p. 268).

4.6.7. Wixom and Todd Model

Wixom and Todd (2005) developed an integrated research model which distinguishes beliefs and attitudes *about* the system (object-based beliefs and attitudes) from beliefs and attitudes about *using* the system (behavioural beliefs and attitude) to build a theoretical logic that links the user satisfaction (CUS) and technology acceptance (TAM) models. According to the authors, the proposed model (cf. Figure 4.10) provides preliminary evidence that the two perspectives can, and should, be integrated. They further state that the integrated model helps to bridge the gap between system characteristics (the core strength of the user satisfaction literature) and the prediction of usage (the core strength of technology acceptance literature).

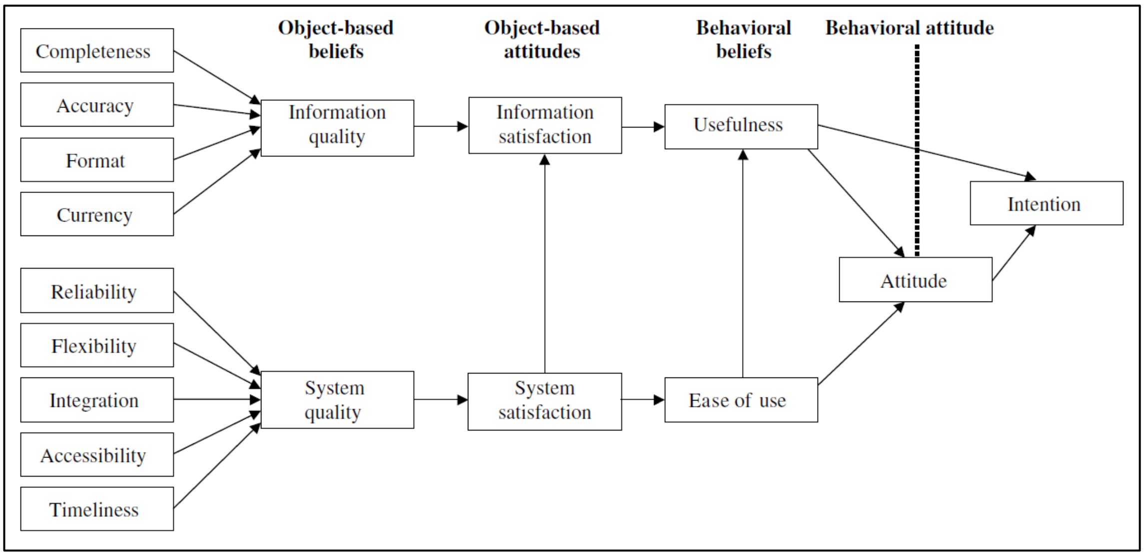


Figure 4.10. The Wixom and Todd conceptual model (Wixom & Todd, 2005, p. 90).

4.6.8. Task-Technology Fit (TTF) model

Essentially, the Task-Technology Fit (TTF) model proposes that IT is more likely to have a positive impact on individual performance (dependent variable) and that it is more likely to be used if the capabilities of the IT match the tasks that the user must perform (Goodhue & Thompson, 1995).

Goodhue and Thompson (1995) developed a measure of task-technology fit that consists of eight factors: *quality*, *locatability*, *authorisation*, *compatibility*, *ease of use/training, production timeliness, systems reliability* and *relationship with users* (Goodhue & Thompson, 1995).

Figure 4.11 depicts the TTF model as suggested by the authors (Goodhue & Thompson, 1995). Figure 4.11 shows that both the *theories of fit* and the *theories of attitudes and behaviour* underlie the TTF model. Apart from *task* and *technology* characteristics, the comprehensive model also includes *individual* characteristics as independent variables to establish a *task-technology fit* measure (dependent variable). The dependent variable, *performance impacts,* serves as the final success measure. Hence, the model proposes that if the characteristics of the task performed by the user, the characteristics of the technology used by the user and the individual characteristics of the user are a good fit then the user will demonstrate efficient performance and the utilisation of the system will increase (Goodhue & Thompson, 1995).

The TTF measure, in conjunction with utilisation, was found to be a significant predictor of user reports of improved job performance and effectiveness that was attributable to their use of the system under investigation (Goodhue & Thompson, 1995). The model furthermore suggests that task-technology fit, when decomposed into its more detailed components, could be the basis for a strong diagnostic tool to evaluate whether information systems and services in a given organisation are meeting user needs (Goodhue & Thompson, 1995).

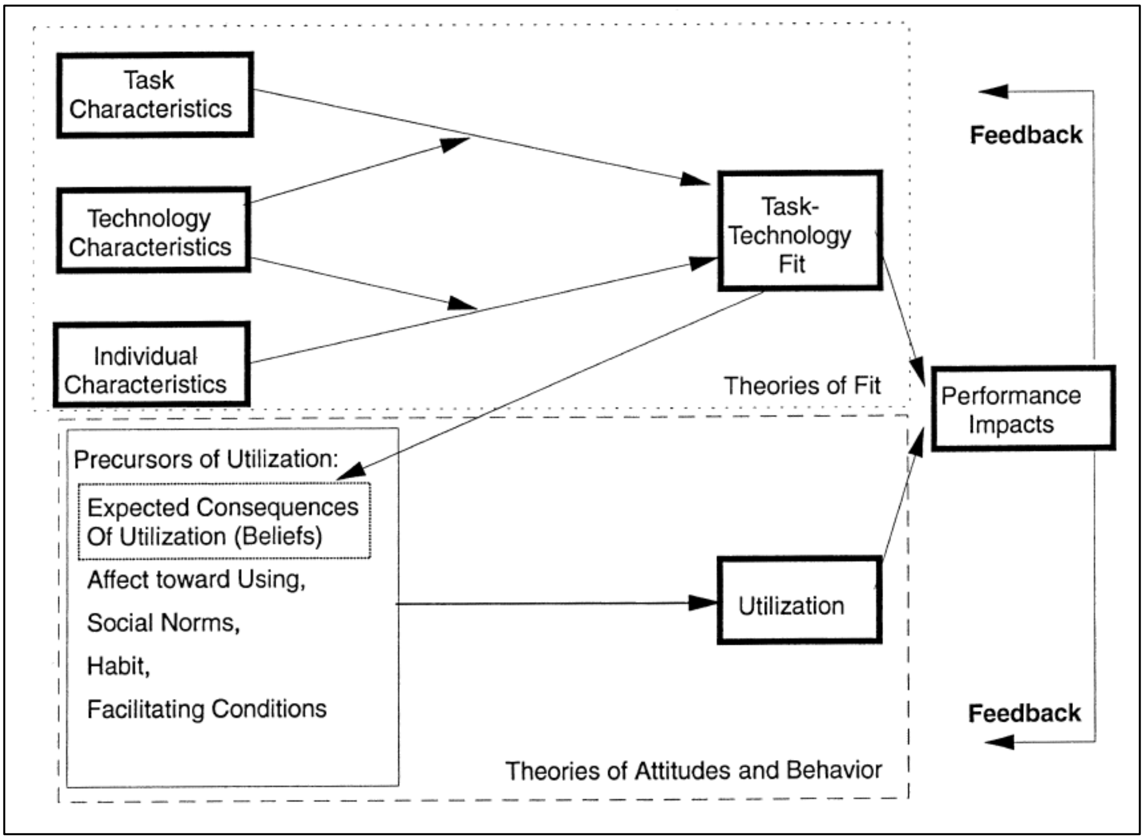


Figure 4.11. Task-Technology Fit model (Goodhue & Thompson, 1995, p. 217).

4.6.9. The original DeLone and McLean (D&M) information systems success model

DeLone and McLean (1992) reviewed the literature published from 1981 to 1987 in seven publications to develop a taxonomy of IS success. Five of the seven publications reviewed (*Management Science, MIS Quarterly, Communications of the ACM, Decision Sciences* and *Information & Management*) were drawn from the top six journals cited by Hamilton and Ives (1983) in their study of the journals most respected by MIS researchers. To these five were added the *Journal of MIS* and the *ICIS Proceedings*, which is not a journal per se, but represents the published output of the central academic conferences in the IS field. A total of 100 empirical studies were included from these seven sources (DeLone & McLean, 1992).

This taxonomy was based on Richard Mason's modification of Shannon and Weaver's (1949) mathematical theory of communications which identified three levels of information:

- the technical level (accuracy and efficiency of the system that produces it);
- the semantic level (its ability to transfer the intended message); and
- the effectiveness level (its impact on the receiver) (Shannon & Weaver, 1949, p. 2).

Mason adapted this theory for IS and expanded the effectiveness level into three categories: *receipt of information*, *influence on the recipient* and *influence on the system* (Mason, 1978).

DeLone and McLean identified categories for IS success by mapping an aspect of IS success (found in the literature review) to each of Mason's effectiveness levels (DeLone & McLean, 1992). This analysis yielded six variables of success: System Quality; Information Quality; Use; User satisfaction; Individual impact and Organisational impact. *System quality* is equivalent to the technical level of communication, while *information quality* is equivalent to the semantic level of communication. The other four variables are mapped to Mason's sub-categories of the effectiveness level. *Use* relates to Mason's *receipt of information*; *user satisfaction* and *individual impact* are associated with the *information's influence on the recipient* and *organisational impact* is the *influence of the information on the system*. A diagram illustrating the development of the original D&M IS success model from the theory of communication is presented in Figure 4.12.

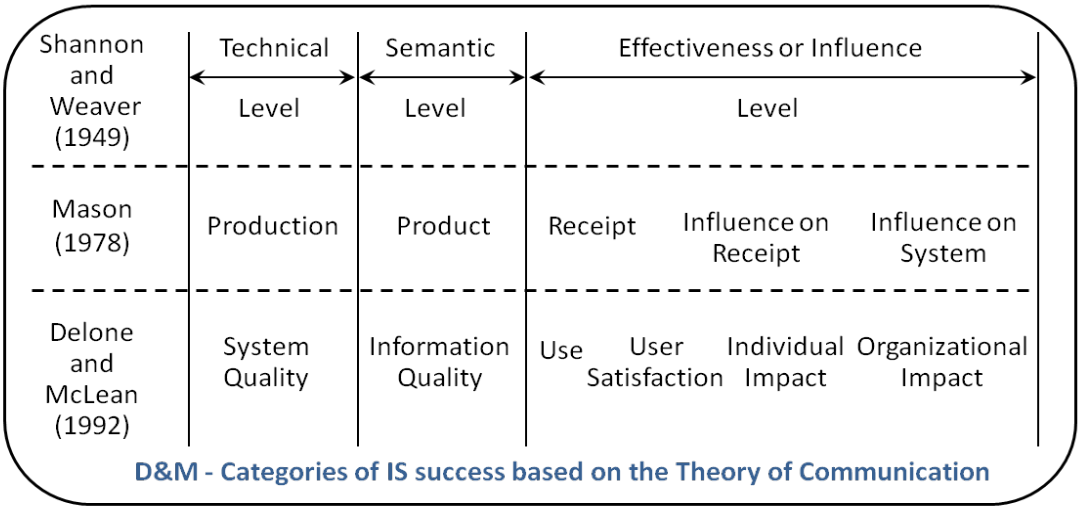


Figure 4.12. Categories of IS success adapted from DeLone and McLean (1992, p. 62).

DeLone and McLean developed their initial taxonomy using established theories of communication adapted to IS. These theories suggested that the flow of information was linear; however, they proposed that, for IS these different measures of success were independent, but that there was interdependency amongst them (DeLone & McLean, 1992). Figure 4.13 presents the original D&M IS success model. DeLone and McLean suggest that researchers should use this model in a predictive manner, although they cautioned that one must measure and/or control each of the variables in the model to ensure a complete understanding of IS success. DeLone and McLean called upon others to validate their model (DeLone & McLean, 1992).

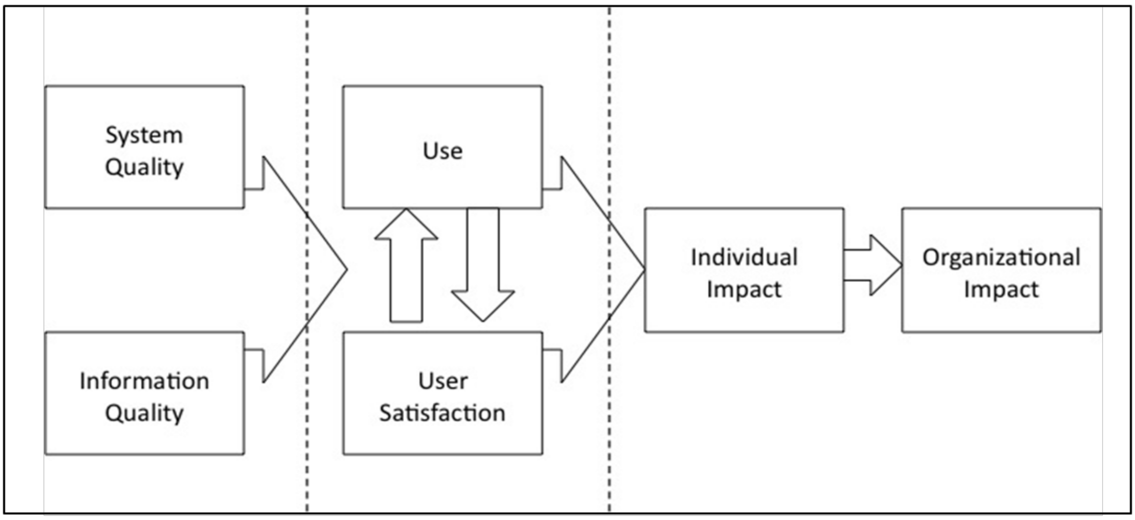


Figure 4.13. D&M Initial IS success Model (DeLone & McLean, 1992, p. 87).

4.6.10. Updated DeLone and McLean (D&M) IS success model

In the years following DeLone and McLean's presentation of their original IS success model, several researchers altered or extended the model, while others adapted it for specific applications, such as knowledge management or e-commerce systems (Petter, DeLone & McLean, 2008). Recognising these potential improvements over their original model, DeLone and McLean acknowledged these modifications and revised their model accordingly (DeLone & McLean, 2003). The updated model is depicted in Figure 4.14. DeLone and McLean also modified their model to address some of the limitations of the original model. They acknowledged that *quality* should include *information*, *system* and *service* quality. Therefore, a key addition to the updated model was the inclusion of *service quality* as an additional aspect of IS success (DeLone & McLean, 2003) which was added because the changing nature of IS required the assessment of service quality when evaluating IS success. DeLone and McLean also recommended assigning different weights to *system quality*, *information quality* and *service quality,* depending on the context and application of the model (DeLone & McLean, 2003).

In addition, DeLone and McLean (2003) noted that since the impacts of IS had evolved beyond the immediate user, researchers suggested additional IS impact measures, such as work group impacts, inter-organisational and industry impacts, consumer impacts and societal impacts. Accordingly, they decided to group all the impact measures into a single impact, or benefit category, called *net benefits*. Although they acknowledged that for some studies such finer granularity may be appropriate, they resisted further refinements for the sake of parsimony.

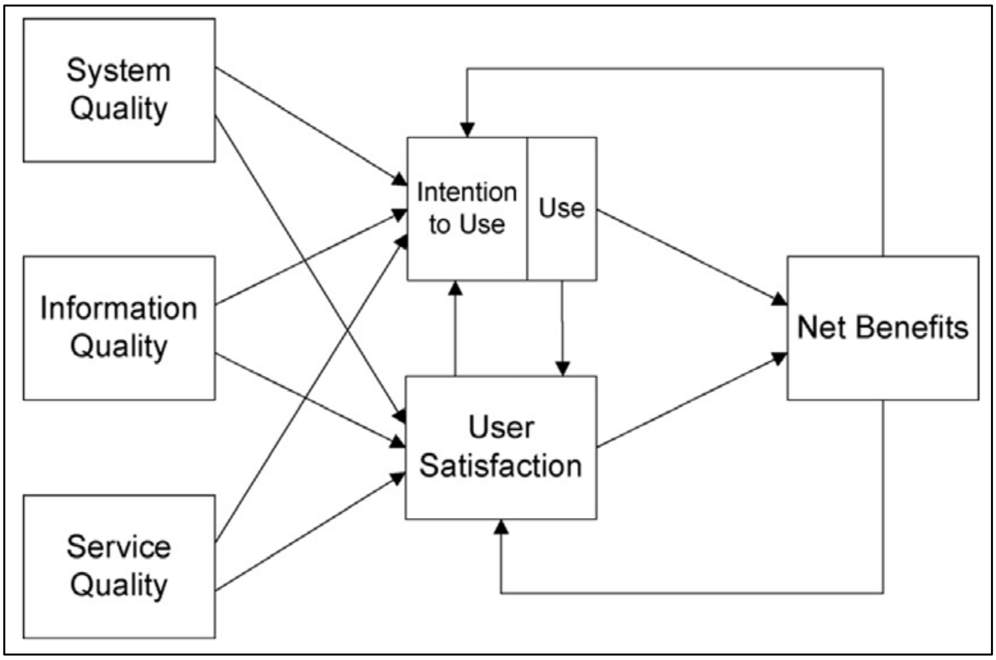


Figure 4.14. D&M updated IS success Model (DeLone & McLean, 2003, p. 24).

4.6.11. Model of User Satisfaction

In 1996, Seddon and Kiew undertook a partial test of D&M's initial model of IS success in small businesses, even though with some changes to the underlying theoretical assumptions (Seddon & Kiew, 1996). Seddon and Kiew critically examined the meaning of four of D&M IS success model's constructs and the interrelationships between them (i.e. *system quality*, *information quality*, *use* and *user satisfaction*).

In their evaluation, they modified the construct, *use*, because they "conjectured that the underlying success construct that researchers have been trying to tap is *usefulness*, not *use"* (Seddon & Kiew, 1996). Seddon and Kiew's concept of usefulness is equivalent to Davis's idea of perceived usefulness in TAM (Davis, Bagozzi & Warshaw, 1989). Seddon and Kiew argued that, for voluntary systems, *use* is an appropriate measure; however, if *system use* is mandatory, *usefulness* would be a better measure of IS success than *use*. DeLone and McLean (2003) responded that, even in mandatory systems, there could still be considerable variability of *use* and therefore the variable *use* deserves to be retained. Seddon and Kiew's conceptual model is depicted in Figure 4.15.

Seddon and Kiew's study found good support for the D&M IS success model. They also found that *user satisfaction* is the most general individual-user perceptual measure of information system success. They further noted that researchers would need to control for *task importance* whenever they measure the *usefulness* of an information system, because systems that perform more important tasks are perceived as being more useful (Seddon & Kiew, 1996).

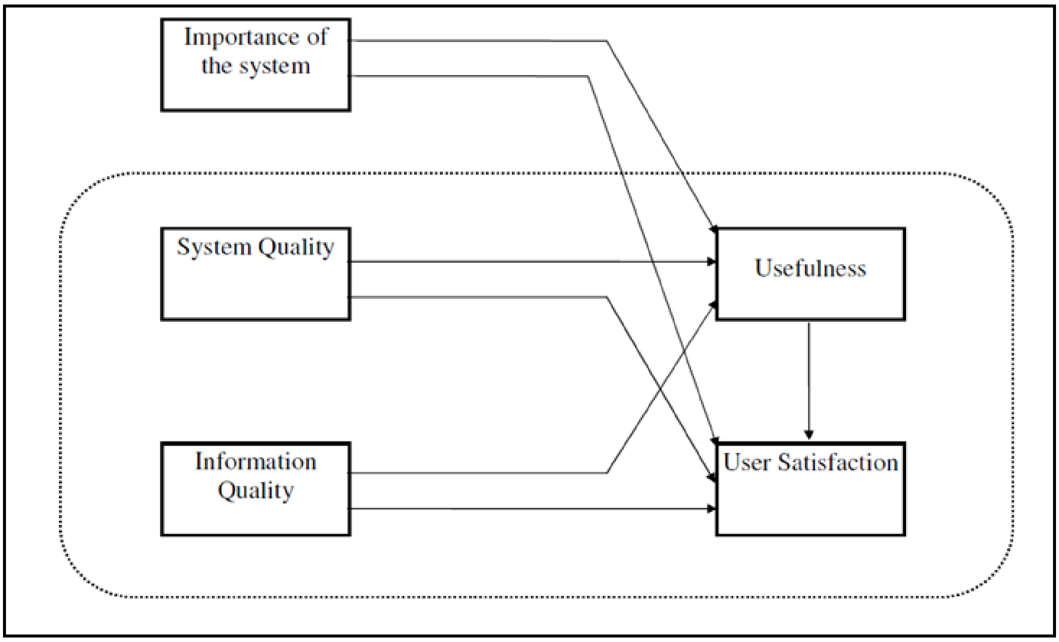


Figure 4.15. Seddon and Kiew's model of user satisfaction (Seddon & Kiew, 1996, p. 92).

4.6.12. Re-specified D&M IS Success Model

Seddon (1997) emphasised the fact that D&M, in their comprehensive review of different IS success measures, contributed firstly by providing a scheme for classifying the multitude of IS success measures into six categories and, secondly, by proposing a model of "temporal and causal" interdependencies between these categories (DeLone & McLean, 1992, p. 88). Seddon further argued that the problem with the D&M IS success model is that it combines variance and process models which cause confusion in the meanings of the different relations and constructs. In addition, Seddon stated that the D&M IS success model is actually a combination of three models:

- a variance model of IS success, where the independent variables are *system quality* and *information quality*, and the dependent variables are *IS use* (for benefits of use) and *user satisfaction;*
- a variance model of *IS use* (as the dependent variable of future IS use) as a behaviour; and
- a process model of IS success, where *IS use* is an event in a process leading to *individual* or *organisational impact* (Seddon, 1997, p. 244).

The re-specified model of IS Success (and Use) by Seddon is depicted in Figure 4.16.

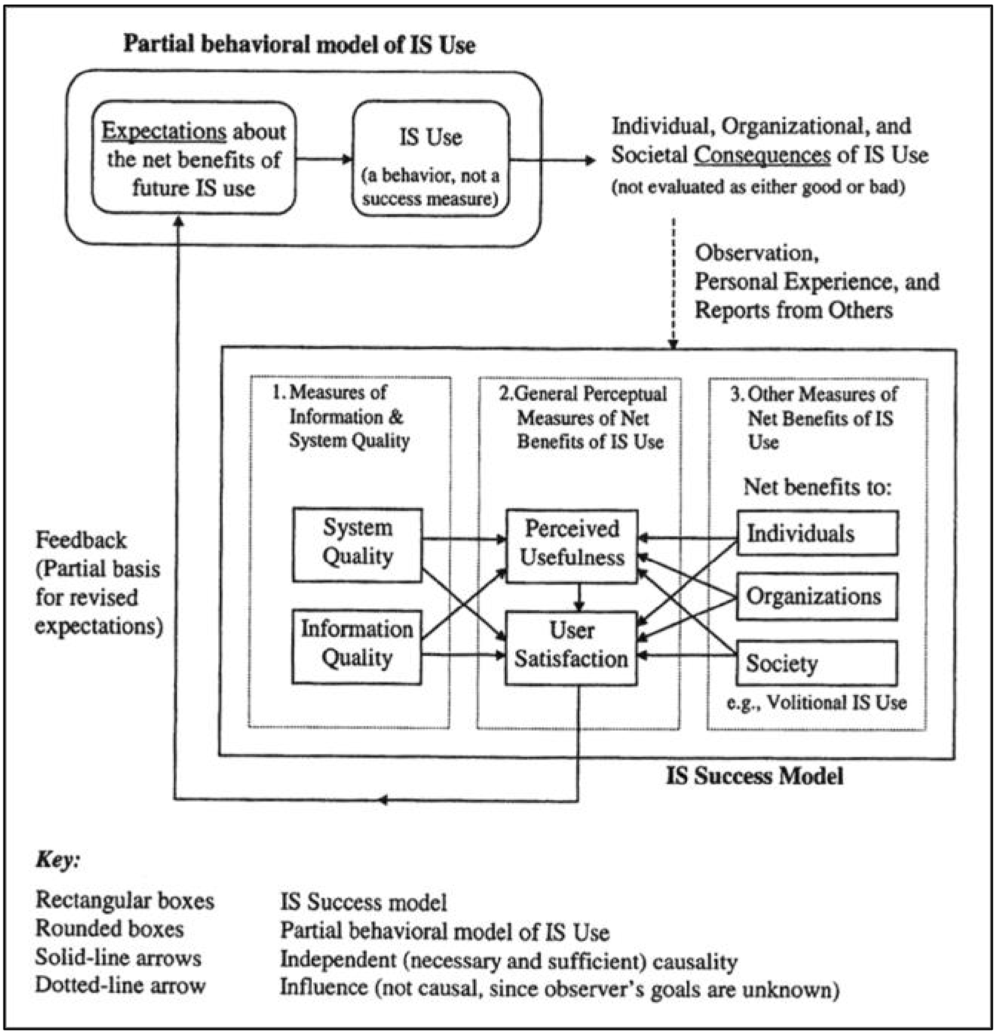


Figure 4.16. Re-specified model of IS success (and Use) (Seddon, 1997, p. 245).

Starting at the top left of Figure 4.16, the behavioural variance model assumes that higher levels of *expectations* about net benefits of future IS use will lead to higher levels of *IS use*. This model is intended to be consistent with the work of Davis *et al*. (Davis, 1989, 1993; Davis, Bagozzi & Warshaw, 1989) related to the TAM (cf. sections 4.5.1 to 4.5.5). The consequences of *IS use* are represented by the block containing the *individual*, *organisational* and *societal* consequences of IS use. Inside the rectangle labelled *IS success model* a complex set of variance model relationships between seven IS success measures, arranged in three columns, is found which correlates with the D&M constructs. The final relationship is the feedback path from *IS success* to *expectations* in the behavioural model. It is hypothesised that higher *net benefits* from past use will lead to higher *expectations* about future benefits (Seddon, 1997).

The focus of the re-specified model is still very much the same as D&M's IS success model. The six categories of IS success measures and two of the three meanings of *IS use* implicit in the D&M IS success model are present in the re-specified model.

4.6.13. The Extended DeLone-McLean Model

Mardiana, Tjakraatmadja and Aprianingsih (2015) evaluated the D&M IS success model based on meta-analysis studies in the literature. They searched for weak relationships in the IS success model – those relationships between constructs within the model that are the least significant, or weakly supported. The authors found that the D&M model lacks foundational theory for predicting *intention to use*. Therefore, they proposed additional theory which is expressed in the additional variables to strengthen the supporting philosophical theory (Figure 4.17).

Based on the literature review they proposed the separation of the dimensions *intention to use* and *use* and the integration of Technology Acceptance Model (TAM) and the Unified Theory of Acceptance and Use of Technology (UTAUT). According to the authors the integration of TAM and UTAUT into the D&M IS success model is necessary to provide proper antecedents for *intention to use* since TAM provides a stronger and sound theoretical background to predict behavioural intention (Mardiana, Tjakraatmadja & Aprianingsih, 2015).

Conceptually, UTAUT is an extension of TAM and TAM is designated for general use of computer or technology while UTAUT is specified for mandatory use of technology (Venkatesh *et al.*, 2003). The proposed model is presented in Figure 4.17.

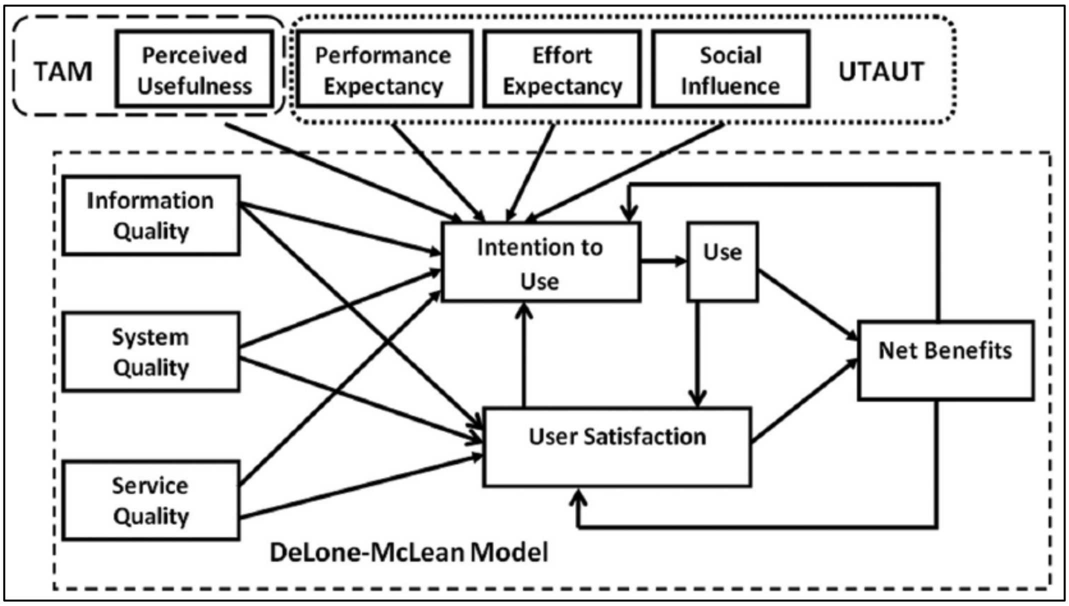


Figure 4.17. The Extended D&M Model (Mardiana, Tjakraatmadja & Aprianingsih, 2015, p. 180).

4.6.14. SA-FETMIS Success Model

The SA-FETMIS success model was designed and empirically tested for use in a specified context. The specific context is public Technical and Vocational Education and Training (TVET) Colleges in South Africa. The SA-FETMIS success model is a combination of the Original D&M IS Success Model, Updated D&M IS Success Model and the adjusted End-User Computing Satisfaction Model (Figure 4.18). The model was developed by Visser *et al*. (2012; 2013) as outcome of a study on the investigation of suitable models for the evaluation of management information systems deployed at public TVET Colleges in South Africa. Staff members at the college were obligated to use the system therefore the dimension of *intention to use and use* was omitted from the Updated D&M IS success model. The study provides empirical evidence in support of the D&M IS Success Model as a base model for measuring IS success. Based on empirical evidence, the initial proposed conceptual model was adapted to include antecedent variables for the dimensions: *information* and *systems quality* and for *user satisfaction*, as depicted in Figure 4.18.

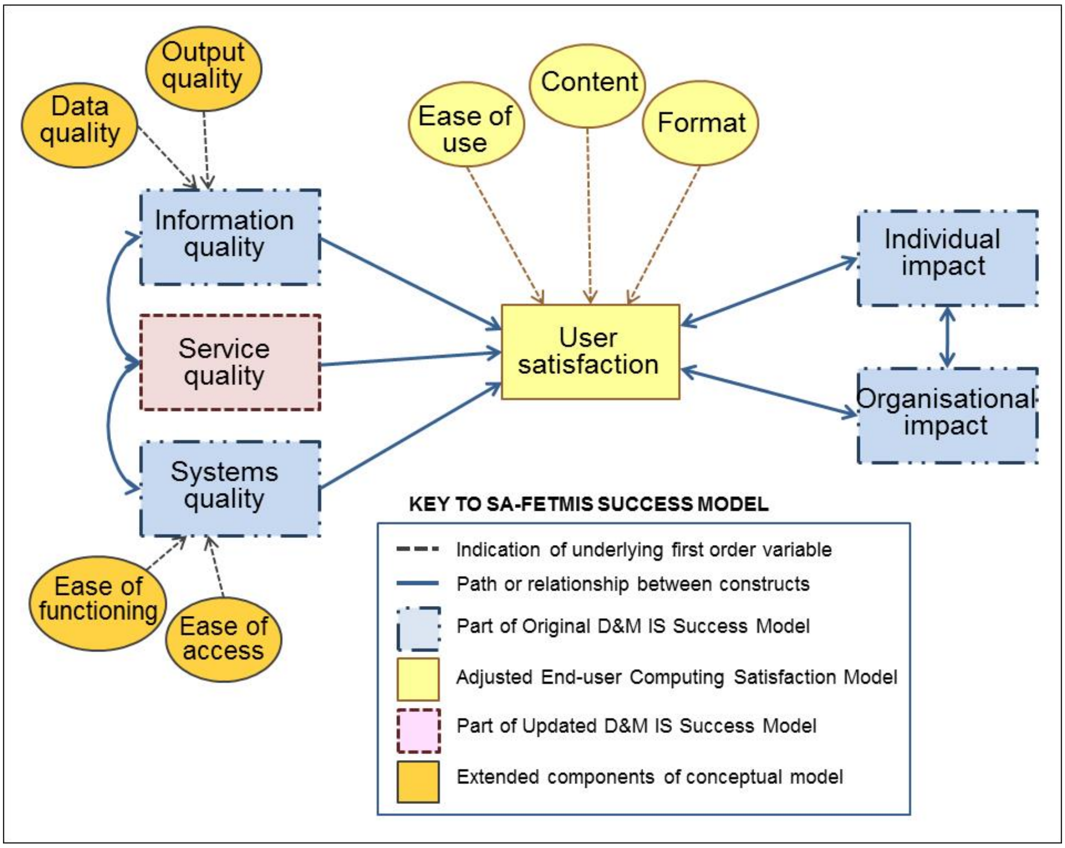


Figure 4.18. The SA-FETMIS Success Model (Visser, van Biljon & Herselman, 2013, p. 4).

4.6.15. Synthesis of reviewed IS success models

In summary, Figure 4.19 depicts a flow chart of the different reviewed IS success models with their extensions as well as combinations of the different models. The base models are presented in rectangles and the updated models, extensions and combinations are represented in rounded rectangles.

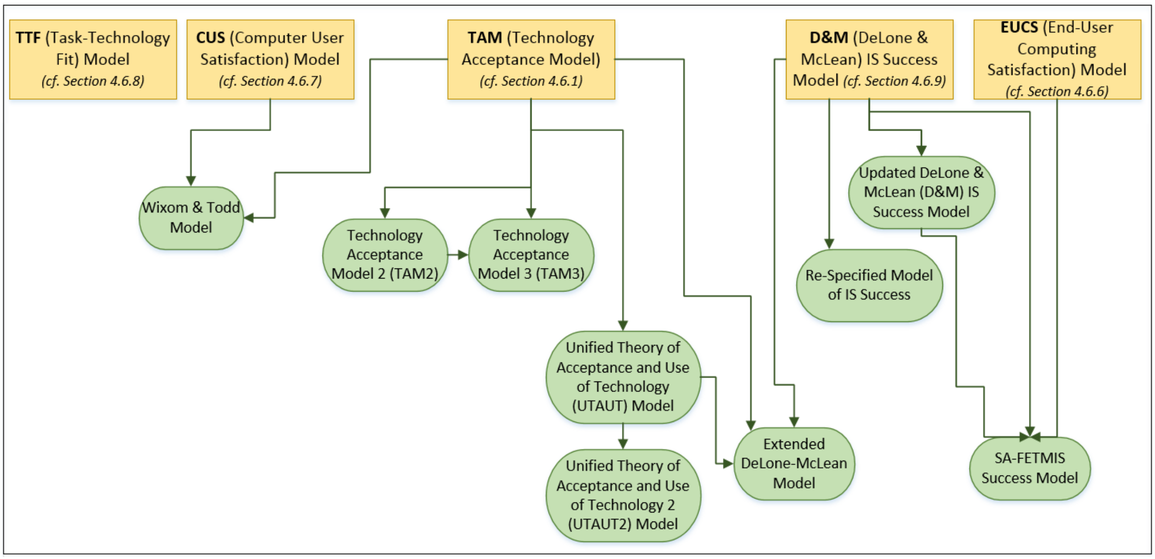


Figure 4.19. Summary of the reviewed IS success models.

4.7. Motivation for the selected base model

The preceding sections reviewed extant IS success models found in the literature and therefore addressed the second sub-research question: *What models exist to support the evaluation of MISs at public TVET Colleges?* (cf. section 1.2.3.3)

Based on the review and consideration of the IS success models found in the literature, it was decided to select the D&M IS success model as the basis for *Phase C: Procedures* and *Phase D: Toolkit* of the TVET-MIS-EVAL methodology. The review of the models revealed that the main dimensions identified by D&M in 1992 namely *systems quality*, *information quality*, *information use*, *individual impact* and *organisational impact,* are still considered relevant and are still being empirically tested and used by many IS researchers in different contexts. The overwhelming evidence and support in the literature on the strength of the D&M IS success model led to this decision.

Since the context of the SA-FETMIS success model is public TVET Colleges in South Africa, it was decided to investigate this model in more detail for the purpose of inclusion in the TVET-MIS-EVAL methodology (artefact).

Furthermore, since the TVET-MIS-EVAL methodology needs to be applied to public TVET Colleges in which specified users are already using the MISs (to be evaluated) deployed at the colleges, technology acceptance is assumed in advance, although it is also acknowledged that acceptance of an information system is a necessary precondition to IS success, as argued by Petter *et al*. (2008). In addition, technology acceptance is not equivalent to IS success and therefore the theory of reasoned action and constructs of the TAM namely *perceived usefulness* and *perceived ease of use* which contributes to *attitude towards using the system* were considered irrelevant to the TVET-MIS-EVAL methodology. Therefore, the TAM and its extensions were not considered suitable for inclusion in *Phase C: Procedures* and *Phase D: Toolkit* of the TVET-MIS-EVAL methodology (artefact). Instead the construct, *user satisfaction* as presented in the End-user Computing Satisfaction model which encompasses: *content*, *accuracy*, *format*, *ease of use* and *timeliness* attributes was found to be suitable and relevant to the study context.

The proposed theoretical model(s) on which the TVET-MIS-EVAL methodology procedures (Phase C) and toolkit (Phase D) phases are based, as derived from the reviewed literature, is presented in the next section.

4.8. Model for the TVET-MIS-EVAL methodology

The SA-FETMIS success model was selected to serve as the basis of the proposed theoretical base model for the *procedures* and *toolkit* phases of the TVET-MIS-EVAL methodology because this model is grounded on the original D&M IS Success Model, the updated D&M IS Success Model and the End-User Computing Satisfaction Model (EUCS) and the model has already been empirically tested in the public TVET College context in South Africa.

Figure 4.20 presents the framework of the proposed theoretical base model for the *procedures and toolkit* phases of the TVET-MIS-EVAL methodology. The dimensions or IS success constructs: systems quality, information quality, service quality, user satisfaction, individual impact and organisational impact serve as both dependent and independent variables. They are dependent on underlying independent contributing attributes and they also contribute to the dependent variable of *IS success*. Further investigation is needed to determine the independent variables with which the six dimensions, or IS success constructs, can be measured. The proposed theoretical model furthermore presents inter-relationships between dimensions. The inter-relationships will be retained and further verification of the strengths of these inherent relationships will be investigated in Chapter 8, in which the results of the empirical application of the TVET-MIS-EVAL methodology on three selected public TVET Colleges will be presented.

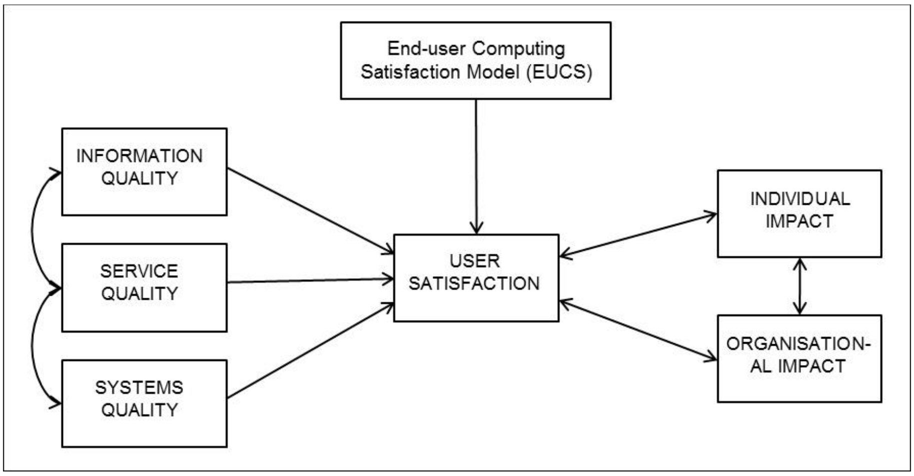


Figure 4.20. Proposed theoretical framework of the TVET-MIS-EVAL methodology procedures and toolkit phases.

The theoretical model proposed as the foundation of *Phase C: Procedures* and *Phase D: Toolkit* of the TVET-MIS-EVAL methodology will be empirically validated during the demonstration and evaluation phases of the design science research process (DSRP) model (Peffers *et al.*, 2006), which underpins the study's research process.

The following section will be devoted to the search for effectiveness measures or items for incorporation in measuring tools and procedures which will include variables that contribute to the measurement of the six IS success constructs.

4.9. Constructs and effectiveness measures

The theoretical framework of the IS success base model selected for the procedures and toolkit phases (cf. Figure 4.20), guided a literature review in search for effectiveness measures for each of the six IS success constructs.

The literature review revealed that, although different researchers propose IS success models with different constructs and effectiveness measures, similarities can be identified, as illustrated in Table 4.6. In Table 4.6, a synthesis of the proposed effectiveness measures of the six constructs in the theoretical framework of the procedures and toolkit phases of the TVET-MIS-EVAL methodology found in the literature is given.

The literature furthermore suggests that in addition to the technological aspects (six IS success constructs), the task, user, organisational and project characteristics which are associated with the IS success constructs, should also be investigated for a more holistic description of the context of the information system under evaluation. Petter, DeLone and McLean (2013) reviewed 140 IS success studies that were conducted over a 15-year period. The authors searched for independent variables that support the six IS success constructs. The comprehensive and integrative study of previous research revealed 43 variables that have been posited as determinants of IS success. The 43 variables were grouped into five determinant categories: Task, Individual, Social, Project, and Organisational. These success factor categories are consistent with the constructs identified by Leavitt's Diamond of Organisational Change (Leavitt, 1965) as depicted in Table 4.5. The underlying effectiveness measures (independent variables) of these categories are listed in the last column of the synthesis presented in Table 4.6.

Table 4.5. Mapping between Leavitt's Diamond and IS success antecedent categories.

Leavitt's constructs	Antecedent category
Task	Task characteristics
People	User characteristics Social characteristics
Structure	Project characteristics Organisational characteristics
Technology	Dependent variables of IS success (System Quality, Information Quality, Service Quality, Intention to Use, Use, User Satisfaction, Individual Impact, Organisational Impact)

Source: (Petter, DeLone & McLean, 2013, p. 15)

Table 4.6 forms the basis for the design and development of tools for the procedures and toolkit phases within the TVET-MIS-EVAL methodology.

Table 4.6. A comparison of IS success constructs with their effectiveness measures proposed by IS practitioners and researchers.

1992 **D&M Success Model Conceptual framework** **(DeLone & McLean, 1992)**	**2004** **D&M Success Model: Updated E-commerce Success Metrics Conceptual framework** **(DeLone & McLean, 2004)**	**2010** **Relationships among ERP post-implementation success constructs: An analysis at the organisational level** **(Ifinedo, Rapp, Ifinedo & Sundberg, 2010)**	**2011** **Towards developing an evaluation tool for business management information systems' success at public Further Education and Training (FET) Colleges in South Africa** **(Visser, 2012)**	**2013** **Information systems success: The quest for the independent variables** **(Petter, DeLone & McLean, 2013)**
Systems quality	**Systems quality**	**System quality**	**System quality**	**System quality**
Data accuracy	Adaptability	System has accurate data	Easy to use	Technology experience
Data currency	Availability	System is flexible	Easy to learn	Self-efficacy
Database contents	Reliability	System is easy to use	Accessible	Third party interaction
Ease of use	Response time	System is easy to learn	Integrated and consistent data	Management processes
Ease of learning	Usability	System is reliable	Meets information requirements	Development approach
Convenience of access		System allows data integration	User interface easily adaptable	Enjoyment
Human factors		System is efficient	Always up-and-running	Project management skill
Realisation of user requirements		System allows for customisation	Response time	IT Planning
Usefulness of system features and functions		System allows for integration with other IT systems	Modifiable	Developer skill
System accuracy		System's content is good		Age
System flexibility		System meets users' requirements		Trust
System reliability				Task interdependence
System sophistication				Management support
Integration of systems				Education
System efficiency				Organisational role
Resource utilisation				Task specificity
Response time				Task compatibility
Turnaround time				
Information quality	**Information quality**	**Information quality**	**Information quality**	**Information quality**
Importance	Completeness	System has timely information	Importance of information	IT infrastructure
Relevance	Ease of understanding	Information is understandable	Contain all key data	Management processes
Usefulness	Personalisation	Information is important	Accuracy of data and information	Organisational competence
Informativeness	Relevance	Information is brief/concise	Updated and current data	Extrinsic motivation
Usableness	Security	Information is relevant	Relevant outputs	Management support
Understandability		Information is usable	Availability of information	IT planning
Readability		Information is available	Readily usable format	Technology experience
Clarity			Easily understandable	Trust

Table 4.6. A comparison of IS success constructs with their effectiveness measures proposed by IS practitioners and researchers.

1992 **D&M Success Model Conceptual framework (DeLone & McLean, 1992)**	**2004** **D&M Success Model: Updated E-commerce Success Metrics Conceptual framework (DeLone & McLean, 2004)**	**2010** **Relationships among ERP post-implementation success constructs: An analysis at the organisational level (Ifinedo, Rapp, Ifinedo & Sundberg, 2010)**	**2011** **Towards developing an evaluation tool for business management information systems' success at public Further Education and Training (FET) Colleges in South Africa (Visser, 2012)**	**2013** **Information systems success: The quest for the independent variables (Petter, DeLone & McLean, 2013)**
Format			Concise information	Task variability
Appearance			Timeliness	
Content			Uniqueness	
Accuracy				
Precision				
Conciseness				
Sufficiency				
Completeness				
Reliability				
Currency				
Timeliness				
Uniqueness				
Comparability				
Quantitativeness				
Freedom from bias				
	Service quality	**Service quality**	**Service quality**	
	Assurance	System provides prompt info to users	Service provider is reliable	
	Empathy	System has a good interface	Up-to-date facilities	
	Responsiveness	System has visually appealing features	Service provider is experienced	
		System provides the right solution to requests	Provides quality training	
		System service provider is dependable	Provides quality services	
		System service provider has up-to-date facilities		
		System service provider is experienced and provides quality training and services		

Table 4.6. A comparison of IS success constructs with their effectiveness measures proposed by IS practitioners and researchers.

1992 **D&M Success Model Conceptual framework** **(DeLone & McLean, 1992)**	**2004** **D&M Success Model: Updated E-commerce Success Metrics Conceptual framework** **(DeLone & McLean, 2004)**	**2010** **Relationships among ERP post-implementation success constructs: An analysis at the organisational level** **(Ifinedo, Rapp, Ifinedo & Sundberg, 2010)**	**2011** **Towards developing an evaluation tool for business management information systems' success at public Further Education and Training (FET) Colleges in South Africa** **(Visser, 2012)**	**2013** **Information systems success: The quest for the independent variables** **(Petter, DeLone & McLean, 2013)**
Information Use	**Use**			**Use**
Amount of use/duration of use:	Nature of use			Task compatibility
Number of inquiries	Navigation patterns			Extrinsic motivation
Amount of connect time	Number of site visits			Organisational competence
Number of functions used	Number of transactions executed			Self-efficacy
Number of records accessed				IT infrastructure
Frequency of access				Management support
Frequency of report requests				Attitudes toward technology
Number of reports generated				Technology experience
Charges for system use				Management processes
Regularity of use				Developer skill
Used by whom?				Subjective norms
Direct vs. Chauffeured use				Organisational tenure
Binary use: Use vs. non-use				User expectations
Actual vs. reported use				Enjoyment
Nature of use:				Attitudes toward change
Use for intended purpose				User involvement
Appropriate use				External environment
Type of information used				Voluntariness
Purpose of use				IS Governance
Levels of use: General vs. specific				IT investment
Recurring use				IT planning
Institutionalisation/routinisation of use				Third party interaction
Report acceptance				Relationship with developers
Percentage used vs. opportunity for use				Task significance
Voluntariness of use				Visibility
Motivation to use				Education
				Organisational role
				Computer anxiety

Table 4.6. A comparison of IS success constructs with their effectiveness measures proposed by IS practitioners and researchers.

1992 **D&M Success Model Conceptual framework (DeLone & McLean, 1992)**	**2004** **D&M Success Model: Updated E-commerce Success Metrics Conceptual framework (DeLone & McLean, 2004)**	**2010** **Relationships among ERP post-implementation success constructs: An analysis at the organisational level (Ifinedo, Rapp, Ifinedo & Sundberg, 2010)**	**2011** **Towards developing an evaluation tool for business management information systems' success at public Further Education and Training (FET) Colleges in South Africa (Visser, 2012)**	**2013** **Information systems success: The quest for the independent variables (Petter, DeLone & McLean, 2013)**
				Age
User satisfaction	**User satisfaction**		**User satisfaction**	**User satisfaction**
Satisfaction with specifics	Repeat purchases		Information needs	User involvement
Overall satisfaction	Repeat visits		Current content	Task compatibility
Single-item measure	User surveys		Accuracy of content	Management support
Multi-item measure			Consistency in information	Attitudes toward technology
Information satisfaction: Difference between information needed and received			Output format	Relationship with developers
Enjoyment			System user friendly	User expectations
Software satisfaction			Enjoyment	Developer skill
Decision-making satisfaction				Organisational role
				Task difficulty
				Third party interaction
				Organisational size
				Domain expert knowledge
				Development approach
				Voluntariness
				Time since implementation
				Type of IS
				Education
				Trust
				Enjoyment
				Task interdependence
				Subjective norms
				Task significance
				IS Governance
Individual impact	**Net benefits**	**Individual impact**	**Individual impact**	**Individual impact**
Information understanding	Cost savings	System enhances individual creativity	Learning	Task compatibility
Learning	Expanded markets	System enhances organisational learning and recall for individual	Awareness of job related information	Management support

Table 4.6. A comparison of IS success constructs with their effectiveness measures proposed by IS practitioners and researchers.

1992 **D&M Success Model Conceptual framework** **(DeLone & McLean, 1992)**	**2004** **D&M Success Model: Updated E-commerce Success Metrics Conceptual framework** **(DeLone & McLean, 2004)**	**2010** **Relationships among ERP post-implementation success constructs: An analysis at the organisational level** **(Ifinedo, Rapp, Ifinedo & Sundberg, 2010)**	**2011** **Towards developing an evaluation tool for business management information systems' success at public Further Education and Training (FET) Colleges in South Africa** **(Visser, 2012)**	**2013** **Information systems success: The quest for the independent variables** **(Petter, DeLone & McLean, 2013)**
		workers		
Accurate interpretation	Incremental additional sales	System improves individual productivity	Recall of job related information	Management processes
Information awareness	Reduced search costs	System is beneficial for individual's tasks	Job effectiveness	User involvement
Information recall	Time savings	System enhances high-quality decision making	Individual productivity	Task difficulty
Problem identification		System saves time for individual tasks/duties		Domain expert knowledge
Decision effectiveness:				Enjoyment
Decision quality		**Work group impact**		Attitudes toward change
Improved decision analysis		System improves workers' participation in the organisation		Attitudes about technology
Correctness of decision		System improves organisational-wide communication		Task interdependence
Time to make decision		System improves inter-departmental coordination		Third party interaction
Confidence in decision		System creates a sense of responsibility		Subjective norms
Decision-making participation		System improves the efficiency of sub-units in the organisation		Task significance
Improved individual productivity		System improves work-groups productivity		Education
Change in decision		System enhances solution effectiveness		Self-efficacy
Causes management action				Technology experience
Task performance				Time of implementation
Quality of plans				Peer support
Individual power or influence				User expectations
Personal evaluation of information systems				Development approach
Willingness to pay for information				Developer skill

Table 4.6. A comparison of IS success constructs with their effectiveness measures proposed by IS practitioners and researchers.

1992 **D&M Success Model Conceptual framework** **(DeLone & McLean, 1992)**	**2004** **D&M Success Model: Updated E-commerce Success Metrics Conceptual framework** **(DeLone & McLean, 2004)**	**2010** **Relationships among ERP post-implementation success constructs: An analysis at the organisational level** **(Ifinedo, Rapp, Ifinedo & Sundberg, 2010)**	**2011** **Towards developing an evaluation tool for business management information systems' success at public Further Education and Training (FET) Colleges in South Africa** **(Visser, 2012)**	**2013** **Information systems success: The quest for the independent variables** **(Petter, DeLone & McLean, 2013)**
				Image
				Organisational role
				Task specificity
Organisational impact		**Organisational-impact**	**Organisational impact**	**Organisational impact**
Application portfolio:		System reduces organisational costs	Improved productivity	IT infrastructure
Range and scope of application		System improves overall productivity	Improved outcomes and outputs	Management support
Number of critical applications		System enables e-business/e-commerce	Management of increased volumes of business transactions	Type of IS
Operating cost reductions		System provides competitive advantage	Improved business processes	Time since implementation
Staff reductions		System increases customer service satisfaction	Improved communication and relationships	User involvement
Service effectiveness			Contributed to reduced staff costs	External environment
Overall productivity gains		System facilitates business process change	Contributed to reduction in overall costs	Organisational competence
Increased revenues		System supports decision making		Third party interaction
Increased sales		System allows for better use of organisational data resources		Management processes
Increased work volume				Task specificity
Increased market share				
Increased profits				
Return on investment				
Return on assets				
Ratio of net income to operating expenses				
Cost/benefit ratio				
Stock price				
Increased work volume				

Table 4.6. A comparison of IS success constructs with their effectiveness measures proposed by IS practitioners and researchers.

1992 **D&M Success Model Conceptual framework** **(DeLone & McLean, 1992)**	**2004** **D&M Success Model: Updated E-commerce Success Metrics Conceptual framework** **(DeLone & McLean, 2004)**	**2010** **Relationships among ERP post-implementation success constructs: An analysis at the organisational level** **(Ifinedo, Rapp, Ifinedo & Sundberg, 2010)**	**2011** **Towards developing an evaluation tool for business management information systems' success at public Further Education and Training (FET) Colleges in South Africa** **(Visser, 2012)**	**2013** **Information systems success: The quest for the independent variables** **(Petter, DeLone & McLean, 2013)**
Product quality				
Contribution to achieving goals				
				Intention to use
				Attitudes toward technology
				Subjective norms
				Self-efficacy
				Trust
				Technology experience
				Enjoyment
				Task compatibility
				Management processes
				Relationship with developers
				User expectations
				Attitudes toward change
				External environment
				Extrinsic motivation
				Organisational role
				Task significance

The next section illuminates the method utilised for building the components of *Phase C: Procedures* and *Phase D: Toolkit* of the TVET-MIS-EVAL methodology by developing tools for the measurement of each IS success construct.

4.10. Instrument development

Proposed tools for the measurement of the six IS success constructs were developed and designed based on the framework provided in Table 4.6. Literature searches for available and suitable items, or questions for inclusion in the different tools, were conducted.

In the search for appropriate effectiveness measures (items or questions) for measuring each of the IS success constructs, empirically tested survey questionnaires were sourced from studies conducted by researchers including: Doll and Torkzadeh (1988), Jiang *et al*. (2002), Lærum *et al*. (2004), Gable *et al*. (2008), Ong *et al*. (2009), Ifinedo *et al*. (2010) and Visser (2012). The use of empirically tested items is beneficial to the reliability and especially the content validity of a questionnaire, as is evident from McKenzie, Wood, Clark, Kotecki and Brey's (1999) guidelines for content validity in questionnaire development. In the guidelines to creating a survey instrument, the first of four steps is "canvassing the wealth" of available literature (Gable *et al*., 2008, p. 391).

The following sections present the proposed tools and effectiveness measures for measuring each of the six IS success constructs of the conceptual base model for *Phase C: Procedures* and *Phase D: Toolkit* of the TVET-MIS-EVAL methodology. Relevant effectiveness measures (items or questions) from the instruments that were found in the literature are listed in the last column of each table while the literature resources, where the effectiveness measure was found, are provided in the first six columns. The seventh column contains the variable names as they were assigned to the effectiveness measures and which will be used in the MS Access and SPSS databases.

4.10.1. System quality effectiveness measures

As presented in Table 4.6, the quality of a system is defined in terms of attributes such as ease of use, system flexibility, system reliability and ease of learning, as well as the system features of intuitiveness, sophistication, flexibility and response times (Petter, DeLone & McLean, 2008; 2013). Wixom and Todd (2005) suggest the following attributes for system quality: accessibility, timeliness, language, flexibility, integration and efficiency. Twelve effectiveness measures were identified for the measurement of *systems quality* as an IS success construct (Table 4.7).

Table 4.7. Effectiveness measures for system quality.

(Doll & Torkzadeh, 1988, p. 268)	**(Gable, Sedara & Chan, 2008, p. 405)**	**(Lærum, Karlsen & Faxvaag, 2004, p. 9)**	**(Ong, Day & Hsu, 2009, p. 402)**	**(Ifinedo *et al.*, 2010, p. 1146)**	**(Visser, 2012, p. 198)**	**Proposed effectiveness measures for *Phase C: Procedures* and *Phase D: Toolkit* of the TVET-MIS-EVAL methodology based on empirically tested questionnaires used in the six studies on the left:**	
End-user Computing satisfaction (EUCS)	**IS Measurement Model**	**EPJ Evalueringsskjema ASA Leger**	**User satisfaction with Question Answering Systems (USQAS)**	**ERP system success model (ERP)**	**SA-FETMIS Success Model**	**Variable name**	**Question/Item**
EUCS - Ease of use	IS measurement model - System quality	EPJ – Ease of use	USQAS - Ease of use	ERP - System quality	SA-FETMIS – Ease of access	v14c1	The MIS is not easy to use.
EUCS - Ease of use	IS measurement model - System quality	EPJ – Ease of use	USQAS - Ease of use	ERP - System quality	SA-FETMIS – Ease of access	v14c2	The MIS is easy to learn.
	IS measurement model - System quality		USQAS - Ease of use		SA-FETMIS – Ease of access	v14c3	It is not difficult to get access to information that is in the MIS.
	IS measurement model - System quality			ERP - System quality	SA-FETMIS – Ease of functioning	v14c4	All data within the MIS is fully integrated and consistent.
EUCS - Content	IS measurement model - System quality			ERP - System quality	SA-FETMIS – Ease of functioning	v14c5	The MIS meets (the TVET College's) information requirements.
	IS measurement model - System quality	EPJ – system sophistication			SA-FETMIS – Ease of functioning	v14c6	The MIS does not include necessary features and functions.
	IS measurement model - System quality		USQAS - Ease of use		SA-FETMIS – Ease of functioning	v14c7	The MIS always does what it should.

(Doll & Torkzadeh, 1988, p. 268)	**(Gable, Sedara & Chan, 2008, p. 405)**	**(Lærum, Karlsen & Faxvaag, 2004, p. 9)**	**(Ong, Day & Hsu, 2009, p. 402)**	**(Ifinedo *et al.*, 2010, p. 1146)**	**(Visser, 2012, p. 198)**	**Proposed effectiveness measures for *Phase C: Procedures* and *Phase D: Toolkit* of the TVET-MIS-EVAL methodology based on empirically tested questionnaires used in the six studies on the left:**	
End-user Computing satisfaction (EUCS)	**IS Measurement Model**	**EPJ Evalueringsskjema ASA Leger**	**User satisfaction with Question Answering Systems (USQAS)**	**ERP system success model (ERP)**	**SA-FETMIS Success Model**	**Variable name**	**Question/Item**
	IS measurement model - System quality	EPJ – system integration	USQAS - Ease of use	ERP - Service quality	SA-FETMIS – Ease of functioning	v14c8	The MIS user interface (screen) can be easily adapted to one's personal approach (customise).
	IS measurement model - System quality	EPJ – system integration		ERP - System quality	SA-FETMIS – Ease of functioning	v14c9	The MIS is always up-and-running as necessary (it has good connectivity, e.g. to network, server access, etc.).
EUCS - Timeliness	IS measurement model - System quality	EPJ - flexibility		ERP - Service quality	SA-FETMIS – Ease of functioning	v14c10	The MIS programme speed is quick enough (responds quickly).
	IS measurement model - System quality	EPJ – system sophistication		ERP - Service quality	SA-FETMIS – Ease of functioning	v14c11	The MIS requires only the minimum number of fields and screens to achieve a task.
	IS measurement model - System quality	EPJ – system integration		ERP - System quality	SA-FETMIS – Ease of functioning	v14c12	Modifications to the functionality of the MIS can easily be done (modified, corrected and improved).

4.10.2. Information quality effectiveness measures

Information quality relates to the preferred characteristics of systems' outputs (including content, reports, dashboards), which are used in management reports and web pages and include for example, accuracy, precision, reliability, format, volume, relevance, understandability, conciseness, completeness, currency, timeliness and usability (Wixom & Todd, 2005; Petter, DeLone & McLean, 2008; 2013). The instruments sourced from the literature suggest twelve effectiveness measures for measuring *information quality* as depicted in Table 4.8.

Table 4.8. Effectiveness measures for information quality.

(Doll & Torkzadeh, 1988, p. 268)	**(Gable, Sedara & Chan, 2008, p. 405)**	**(Lærum, Karlsen & Faxvaag, 2004, p. 9)**	**(Ong, Day & Hsu, 2009, p. 402)**	**(Ifinedo *et al.*, 2010, p. 1146)**	**(Visser, 2012, p. 198)**	**Proposed effectiveness measures for *Phase C: Procedures* and *Phase D: Toolkit* of the TVET-MIS-EVAL methodology based on the empirically tested questionnaires used in the six studies on the left:**	
End-user Computing satisfaction (EUCS)	**IS Measurement Model**	**EPJ Evalueringsskjema ASA Leger**	**User satisfaction with Question Answering Systems (USQAS)**	**ERP system success model (ERP)**	**SA-FETMIS Success Model**	**Variable name**	**Question/Item**
	IS measurement model - Information quality	EPJ - Updated information		ERP - Information quality	SA-FETMIS – Data quality	v14b1	Information available from the MIS is important.
EUCS - Content		EPJ – frequency of use	USQAS - Information quality		SA-FETMIS – Data quality	v14b2	The MIS contains all the key data that is needed.
EUCS - Accuracy	IS measurement model - Information quality	EPJ – completeness of information			SA-FETMIS – Data quality	v14b3	Information available from the MIS is always accurate (does not often need correction).
EUCS - Timeliness		EPJ – comprehensiveness of information	USQAS - Information quality	ERP - System quality	SA-FETMIS – Data quality	v14b4	Information from the MIS is always updated and current.
EUCS - Content	IS measurement model - Information quality	EPJ – production of summary reports			SA-FETMIS – Data quality	v14b5	The MIS provides output that seems to be exactly what is needed.
	IS measurement model - Information quality	EPJ – quality of content		ERP - Information quality	SA-FETMIS – Data quality	v14b6	Information needed from the MIS is always available.
EUCS - Format	IS measurement model - Information quality	EPJ – accuracy of data	USQAS - Information quality		SA-FETMIS – Output quality	v14b7	Information from the MIS is in a format that is readily usable.
EUCS - Format	IS measurement model - Information quality	EPJ – Format of reports	USQAS - Information quality	ERP - Information quality	SA-FETMIS – Output quality	v14b8	Information from the MIS is easy to understand.
EUCS - Format	IS measurement model - Information quality	EPJ - Timeliness	USQAS - Information quality		SA-FETMIS – Output quality	v14b9	Information from the MIS appears readable, clear and well formatted.
EUCS - Content	IS measurement model - Information quality	EPJ – Information quality		ERP - Information quality	SA-FETMIS – Output quality	v14b10	Information from the MIS is concise.
EUCS - Timeliness	IS measurement model - Information quality	EPJ – Information quality		ERP - Information quality	SA-FETMIS – Output quality	v14b11	Information from the MIS is always timely.
	IS measurement model - Information quality	EPJ – Information quality			SA-FETMIS – Data quality	v14b12	Information from the MIS is unavailable elsewhere.

4.10.3. Service quality effectiveness measures

Service quality refers to the quality of the service or support that system users receive from the IT department and the IT support personnel in general, or for a specific IS, including aspects such as the communication, relationship, attitude of support staff, vendor support, responsiveness, accuracy, reliability, technical competence and empathy of the service provider’s staff (Petter, DeLone & McLean, 2008; 2013). Table 4.9 presents the effectiveness measures for service quality.

SERVQUAL is a tool in the form of a questionnaire that was adapted from the field of marketing and is a popular instrument for measuring the service quality of IS (Pitt, Watson & Kavan, 1995; Jiang, Klein & Carr, 2002). SERVQUAL measures five dimensions of service quality: *reliability* which is the ability to provide accurate and dependable services; *assurance* which refers to employees having trust and confidence through the knowledge and compassion that the service provider conveys; *tangibles* that refer to the physical appearance of the staff, facilities and equipment; *empathy* which refers to the individual attention the service provider provides; and *responsiveness* which is the willingness to help clients by providing prompt response and service (Jiang, Klein & Carr, 2002).

Table 4.9. Effectiveness measures for service quality.

(Jiang, Klein & Carr, 2002, p. 156)	(Gable, Sedara & Chan, 2008, p. 405)	(Lærum, Karlsen & Faxvaag, 2004, p. 9)	(Ong, Day & Hsu, 2009, p. 402)	(Ifinedo *et al.*, 2010, p. 1146)	(Visser, 2012, p. 198)	Proposed effectiveness measures for *Phase C: Procedures* and *Phase D: Toolkit* of the TVET-MIS-EVAL methodology based on the empirically tested questionnaires used in the six studies on the left:	
IS SERVQUAL	**IS Measurement Model**	**EPJ Evalueringsskjema ASA Leger**	**User satisfaction with Question Answering Systems (USQAS)**	**ERP system success model (ERP)**	**SA-FETMIS Success Model**	**Variable name**	**Question/Item**
IS SERVQUAL - Reliability			USQAS - Service quality	ERP - Service quality	SA-FETMIS – Service quality	v14c13	The service provider is reliable.
IS SERVQUAL - Tangibles			USQAS - Service quality	ERP - Service quality	SA-FETMIS – Service quality	v14c14	The service provider has up-to-date facilities.
IS SERVQUAL - Assurance			USQAS - Service quality	ERP - Service quality	SA-FETMIS – Service quality	v14c15	The service provider is experienced.
IS SERVQUAL - Assurance				ERP - Service quality	SA-FETMIS – Service quality	v14c16	The service provider provides quality training.
IS SERVQUAL - Responsiveness			USQAS - Service quality	ERP - Service quality	SA-FETMIS – Service quality	v14c17	The service provider provides quality services.

4.10.4. Individual impact effectiveness measures

Individual impact refers to the impact of using the information system on users' capabilities and effectiveness in completing their tasks on behalf of the organisation (Gable, Sedara & Chan, 2008). Table 4.10 provides the effectiveness measures for individual impact.

Table 4.10. Effectiveness measures for individual impact.

(Doll & Torkzadeh, 1988, p. 268)	**(Gable, Sedara & Chan, 2008, p. 405)**	**(Lærum, Karlsen & Faxvaag, 2004, p. 9)**	**(Ong, Day & Hsu, 2009, p. 402)**	**(Ifinedo *et al.*, 2010, p. 1146)**	**(Visser, 2012, p. 198)**	**Proposed effectiveness measures for *Phase C: Procedures* and *Phase D: Toolkit* of the TVET-MIS-EVAL methodology based on the empirically tested questionnaires used in the six studies on the left:**	
End-user Computing satisfaction (EUCS)	**IS Measurement Model**	**EPJ Evalueringsskjema ASA Leger**	**User satisfaction with Question Answering Systems (USQAS)**	**ERP system success model (ERP)**	**SA-FETMIS Success Model**	**Variable name**	**Question/Item**
	IS measurement model - Individual impact	EPJ – Individual impact	USQAS - Usefulness	ERP - Individual impact	SA-FETMIS – Individual impact	v14a1	I have learnt much through the presence of the MIS.
	IS measurement model - Individual impact	EPJ – Individual impact	USQAS - Usefulness	ERP - Individual impact	SA-FETMIS – Individual impact	v14a2	The MIS enhances my awareness of job related information.
	IS measurement model - Individual impact	EPJ – Individual impact	USQAS - Usefulness	ERP - Individual impact	SA-FETMIS – Individual impact	v14a3	The MIS enhances my recall of job related information.
	IS measurement model - Individual impact	EPJ – Individual impact	USQAS - Usefulness	ERP - Individual impact	SA-FETMIS – Individual impact	v14a4	The MIS enhances my effectiveness in the job.
	IS measurement model - Individual impact	EPJ – Individual impact	USQAS - Usefulness	ERP - Individual impact	SA-FETMIS – Individual impact	v14a5	The MIS increases my productivity.

4.10.5. Organisational impact effectiveness measures

Organisational impact refers to the benefits experienced by the organisation or company as a result of the implementation of the information system applications (Gorla, Somers & Wong, 2010). Table 4.11 presents the effectiveness measures to measure organisational impact.

Table 4.11. Effectiveness measures for organisational impact.

(Doll & Torkzadeh, 1988, p. 268)	**(Gable, Sedara & Chan, 2008, p. 405)**	**(Lærum, Karlsen & Faxvaag, 2004, p. 9)**	**(Ong, Day & Hsu, 2009, p. 402)**	**(Ifinedo *et al.*, 2010, p. 1146)**	**(Visser, 2012, p. 198)**	**Proposed effectiveness measures for *Phase C: Procedures* and *Phase D: Toolkit* of the TVET-MIS-EVAL methodology based on the empirically tested questionnaires used in the six studies on the left:**	
End-user Computing satisfaction (EUCS)	**IS Measurement Model**	**EPJ Evalueringsskjema ASA Leger**	**User satisfaction with Question Answering Systems (USQAS)**	**ERP system success model (ERP)**	**SA-FETMIS Success Model**	**Variable name**	**Question/Item**
	IS measurement model - Organisational impact	EPJ – Organisational and departmental impact		ERP - Organisational impact	SA-FETMIS – Organisational impact	v14d1	The MIS has resulted in overall productivity improvement.
	IS measurement model - Organisational impact	EPJ – Organisational and departmental impact			SA-FETMIS – Organisational impact	v14d2	The MIS has resulted in improved outcomes or outputs.
	IS measurement model - Organisational impact	EPJ – Organisational and departmental impact			SA-FETMIS – Organisational impact	v14d3	The MIS has resulted in an increased capacity to manage a growing volume of activity (e.g. transactions, population growth, etc.).
	IS measurement model - Organisational impact	EPJ – Organisational and departmental impact		ERP - Organisational impact	SA-FETMIS – Organisational impact	v14d4	The MIS has resulted in improved business processes.
	IS measurement model - Organisational impact	EPJ – Organisational and departmental impact		ERP - Organisational impact	SA-FETMIS – Organisational impact	v14d5	The MIS has helped to improve communication and relationships with partners such as DHET, SETAs, government, private companies, etc.
	IS measurement model - Organisational impact	EPJ – Organisational and departmental impact			SA-FETMIS – Organisational impact	v14d6	The MIS is cost effective.
	IS measurement model - Organisational impact	EPJ – Organisational and departmental impact			SA-FETMIS – Organisational impact	v14d7	The MIS has resulted in reduced staff costs.
	IS measurement model - Organisational impact	EPJ – Organisational and departmental impact		ERP - Organisational impact	SA-FETMIS – Organisational impact	v14d8	The MIS has resulted in cost reductions (e.g. inventory holding costs, administration expenses, etc.).

4.10.6. User satisfaction effectiveness measures

As indicated in Table 4.6, user satisfaction refers to users' level of satisfaction with the information system and this includes satisfaction with reports, websites and support services. The literature review revealed that many researchers integrate *user satisfaction* effectiveness measures with measures for IS constructs such as *information quality* and *systems quality*. Petter *et al*. (2008) state that the most widely used multi-attribute instrument for measuring user information satisfaction (UIS) can be found in Ives, Olson and Baroudi (1983). Closer examination of the UIS measuring tool confirms that the UIS instrument incorporates effectiveness measures of all six identified IS success constructs. According to Freeze (2010) user satisfaction is a measure of the successful interaction between an information system and its users. It is also defined as the extent to which users believe that the information system meets their needs (Ives, Olson & Baroudi, 1983). If a system meets the requirements of the users, their satisfaction with that information system will be enhanced (Bharati, 2003). Wixom and Todd (2005) argue that effectiveness measures for user satisfaction can be categorised in usefulness, relevance, user friendliness and ease of use, of the system. Table 4.12 provides the effectiveness measures for user satisfaction.

Table 4.12. Effectiveness measures for user satisfaction.

(Doll & Torkzadeh, 1988, p. 268)	**(Gable, Sedara & Chan, 2008, p. 405)**	**(Lærum, Karlsen & Faxvaag, 2004, p. 9)**	**(Ong, Day & Hsu, 2009, p. 402)**	**(Ifinedo *et al.*, 2010, p. 1146)**	**(Visser, 2012, p. 198)**	**Proposed effectiveness measures for *Phase C: Procedures* and *Phase D: Toolkit* of the TVET-MIS-EVAL methodology based on the empirically tested questionnaires used in the six studies on the left:**	
End-user Computing satisfaction (EUCS)	**IS Measurement Model**	**EPJ Evalueringsskjema ASA Leger**	**User satisfaction with Question Answering Systems (USQAS)**	**ERP system success model (ERP)**	**SA-FETMIS Success Model**	**Variable name**	**Question/Item**
EUCS - Content	IS measurement model – System quality	EPJ – Content	USQAS – Information quality	ERP – Information quality	SA-FETMIS – Content	v14d1	How often does the system provide the precise information you need?
EUCS - Content	IS measurement model – System quality	EPJ – Content	USQAS – Information quality	ERP – Information quality	SA-FETMIS – Content	v14d2	How often does the system provide reports that seem to be just about exactly what you need?
EUCS - Content	IS measurement model - System quality	EPJ – Content	USQAS – Information quality	ERP – Information quality	SA-FETMIS – Content	v14d3	How often does the information content meet your needs?
EUCS - Accuracy	IS measurement model - System quality	EPJ – Accuracy	USQAS – Information quality	ERP – System quality	SA-FETMIS – Accuracy	v14d4	How often is the system accurate?
EUCS - Accuracy	IS measurement model - System quality	EPJ – Accuracy	USQAS – Information quality	ERP – System quality	SA-FETMIS – Accuracy	v14d5	How often are you satisfied with the accuracy of the system?
EUCS - Accuracy	IS measurement model - System quality	EPJ – Accuracy	USQAS – Information quality	ERP – System quality	SA-FETMIS – Accuracy	v14d6	How often have you detected inconsistencies and inaccuracies in the content of the output reports from the system?
EUCS - Format		EPJ – Format		ERP – Information quality	SA-FETMIS – Format	v14d7	How often do you think the output is presented in a useful format?
EUCS - Format		EPJ – Format		ERP – Information quality	SA-FETMIS – Format	v14d7	How often is the information clear?
EUCS - Ease of use	IS measurement model - System quality	EPJ – Ease of use	USQAS – Ease of use	ERP – System quality	SA-FETMIS – Ease of use	v14d8	How often is the system user-friendly?
EUCS - Ease of use	IS measurement model - System quality	EPJ – Ease of use	USQAS – Ease of use	ERP – System quality	SA-FETMIS – Ease of use	v14d7	How often is the system easy to use?
EUCS - Timeliness	IS measurement model - Information quality	EPJ – Timeliness		ERP – System quality	SA-FETMIS – Timeliness	v14d8	How often do you get the information you need in time?
EUCS - Timeliness	IS measurement model - Information quality	EPJ – Timeliness		ERP – System quality	SA-FETMIS – Timeliness	v14d8	How often does the system provide up-to-date information?

According to Petter, DeLone and McLean (2013), and based on Leavitt's Diamond of Organisational Change (Leavitt, 1965), the tools developed in Table 4.7 to Table 4.12 address the *technology* characteristics of the independent variables of IS success. Information about the task characteristics, characteristics of the users of the system and characteristics of the organisation and MIS (structure characteristics) should also be collected for a holistic picture of IS success. Table 4.13 provides the independent variables for *task*, *people* and *structure* characteristics suggested by Petter *et al*. (2013). Chapter 5 will provide more detailed information about the structural characteristics of the MISs deployed at public TVET Colleges by providing findings on a literature review of the context of the study namely MISs at public TVET Colleges.

Table 4.13. Independent variables by characteristic (Petter, DeLone & McLean, 2013, pp. 16–18).

Characteristic	Independent variables
Task	Task compatibility
	Task difficulty
	Task interdependence
	Task significance
	Task variability
	Task specificity
People (user or social characteristics)	Attitudes towards technology
	Attitudes towards change
	Enjoyment
	Trust
	Computer anxiety
	Self-efficacy
	User expectations
	Technology experience
	Organisational role
	Education
	Age
	Gender
	Organisational tenure
	Social characteristics of how other people view or influence the user (subjective norms, image, visibility, peer support)
Structure (project or organisational characteristics)	User involvement
	Relationship with developers
	Third party interaction
	Developer skill
	Development approach
	IT planning
	Project management skills
	Domain expert knowledge
	Type of IS
	Time since implementation
	Voluntariness
	Management support
	Extrinsic motivation

Characteristic	Independent variables
	Management processes
	Organisational competence
	IT infrastructure
	IT investment
	External environment
	IS governance
	Organisational size

The tools developed from the literature presented in Table 4.7 to Table 4.12 will be incorporated in the TVET-MIS-EVAL methodology (artefact) as presented in Chapter 6. The TVET-MIS-EVAL methodology presented in Chapter 6 includes the following phases: Phase A: Principles; Phase B: Guidelines, practices and rules; Phase C: Procedures; Phase D: Toolkit; and Phase E: Standards and values.

4.11. Conclusion

This chapter investigated the objectives of a solution to the second sub-research question namely: *What models exist to support the success evaluation of MISs at public TVET Colleges*?

Based on the literature review distinct differences between the Information Systems research streams: IS success and IS failure were identified (cf. section 4.3). The complexity of evaluating IS success was demonstrated by the description of different existing IS success evaluation models with their underpinning theories (cf. sections 4.4 to 4.6). The reviews informed the motivation for the selection of the SA-FETMIS success model as the base model for the components: *Phase C: Procedures* and *Phase D: Toolkit* of the TVET-MIS-EVAL methodology (cf. sections 4.7 and 4.8). The literature review furthermore informed the development of instruments, or tools, and the effectiveness measures for the evaluation of the different IS success constructs, namely: systems quality, information quality, service quality, user satisfaction, individual and organisational impact (cf. sections 4.9 and 4.10). The developed instruments provide substance to *Phase C: Procedures* and *Phase D: Toolkit* of the TVET-MIS-EVAL methodology.

The next chapter will encompass a literature review of the context of the study namely public TVET Colleges in South Africa with specific impetus on the historical background of the TVET sector and the types of MISs utilised by these institutions to address the third sub-research question, namely, *What are the main characteristics of the research context and the MIS deployed at public TVET Colleges?* (cf. Chapter 1, section 1.2.3.4).

CHAPTER 5. PUBLIC TVET COLLEGES AND MISs DEPLOYED

5.1. Introduction

In Chapter 3, the components of a methodology was investigated which culminated in the creation of the conceptual framework for the TVET-MIS-EVAL methodology (artefact) (cf. Table 3.4). In Chapter 4, the literature was reviewed in search of models for the evaluation of information systems, applicable to public TVET Colleges in South Africa. Chapter 4 concluded by proposing a suitable base model to inform the development of *Phase C: Procedures* and *Phase D: Toolkit* of the conceptual framework of the TVET-MIS-EVAL methodology (cf. sections 4.7 and 4.8). The literature reviewed and described in this chapter focuses on the third sub-research question in support of the main research question of the study namely: *What are the main characteristics of the research context and the MIS deployed at public TVET Colleges?* (cf. section 1.2.3.4). Thus, the information presented in this chapter provides support for the relevance of the research problem and it also informs the development of the components, *Phase A: Principles*, *Phase B: Guidelines, practices and rules* and *Phase C: Procedures* of the conceptual framework of the TVET-MIS-EVAL methodology as presented in Chapter 3 (cf. Table 3.4).

The chapter proceeds in section 5.2 by situating the literature review within the design science research process (DSRP) model context, as depicted in Figure 5.1. Thereafter the keywords that were used to scope the literature overview (cf. Figure 5.2) and the results of the literature overview (cf. Table 5.1) are presented. Subsequent sections present information in the following order: section 5.3 provides the historical background to the TVET College sector; section 5.4 presents information about the MISs deployed at public TVET Colleges and the developments in college reporting systems. The chapter concludes in section 5.5 with a summary of key issues.

5.2. Situation of the literature review

The investigation narrated in this chapter falls within Phase 3 of the research process of the study, as described in section 1.3.4. It addresses the first and second activities of the DSRP model (Peffers *et al.*, 2006, p. 93) (namely: *Identify problem and motivate relevance of the study*; and *define objectives of a solution)* as depicted and shaded in Figure 5.1.

	INPUT →	PROCESS →	OUTPUT
PHASE 1	Literature: Theory, literature, reports, documents, expert discussion and interviews with stakeholders.	Literature review. Introduction to the research problem: *Identify problem and motivation of relevance.*	**Chapter 1:** Introduction to the research study, problem statement and motivation of relevance.
PHASE 2	Information in **Chapter 1.** Literature: theories, models, methods.	Design and develop the research methodology. Literature review: philosophies, paradigms, strategies.	**Chapter 2:** Research design and methodology on how the research problem was addressed.
PHASE 3	**Chapter 1 and 2**. Theory, literature, reports, documents, expert discussion and interviews with stakeholders on: • Methodology development; • IS success evaluation; • MIS at public TVET colleges.	Literature review: the literature studies, document analysis and inferences initialise and address the design science research process (DSRP) model activity: *Define objectives of a solution.*	Production of: • **Chapter 3:** Components of a methodology – output: framework for artefact. • **Chapter 4:** IS success evaluation models – output: model for artefact. • **Chapter 5:** MIS at public TVET colleges: context.
PHASE 4	Information in **Chapters 1-5.**	*Design and development* (Third activity in DSRP) of the initial methodology (artefact) for the evaluation of MIS at public TVET colleges.	**Chapter 6:** Developed TVET-MIS-EVAL methodology including procedures, methods, guidelines, data collection instruments, etc.
PHASE 5	• Theory on Web Maturity Models (WMM) → • Dataset on characteristics of colleges' websites → • Clusters of colleges →	• Design questionnaire based on WMM and evaluate public TVET colleges' websites → • Cluster analysis → • Random selection of one college per cluster →	• Dataset on website characteristics of public TVET colleges • Three clusters of public TVET colleges • Sample of three colleges **Chapter 7**
PHASE 6	Developed TVET-MIS-EVAL methodology – **Chapter 6.** Selected cases – **Chapter 7.**	DSRP activities: *Demonstrate, Evaluate, Communicate.* Also referred to as *design-demonstrate-evaluate* and *build-and-evaluate* iterations Demonstration and evaluation - College 1 Demonstration and evaluation - College 2 Demonstration and evaluation - College 3 Optimized evaluation methodology (artefact)	**Chapter 8:** • Findings from demonstration and evaluation on College 1 • Findings from demonstration and evaluation on College 2 • Findings from demonstration and evaluation on College 3 • Refinements to the TVET-MIS-EVAL methodology (artefact)
PHASE 7	**Chapter 1-8**	Conclude, synthesise, reflect, write and collate (DSRP activity: *Communicate*).	**Chapter 9:** Conclusion

Figure 5.1. Research process of the study delineated by phases, inputs, activities and outputs, underpinned by the design science research process (DSRP) model (Peffers *et al.*, 2006, p. 93).

Figure 5.2 highlights the section of the systematic literature review of the study relevant to this chapter. The framework for the systematic literature review of the study was initially introduced in section 1.3.1. The literature review for this chapter was initiated with keyword searches on: *Public TVET College*; *Public FET College*; *MIS at public TVET College* and *MIS at public FET College*.

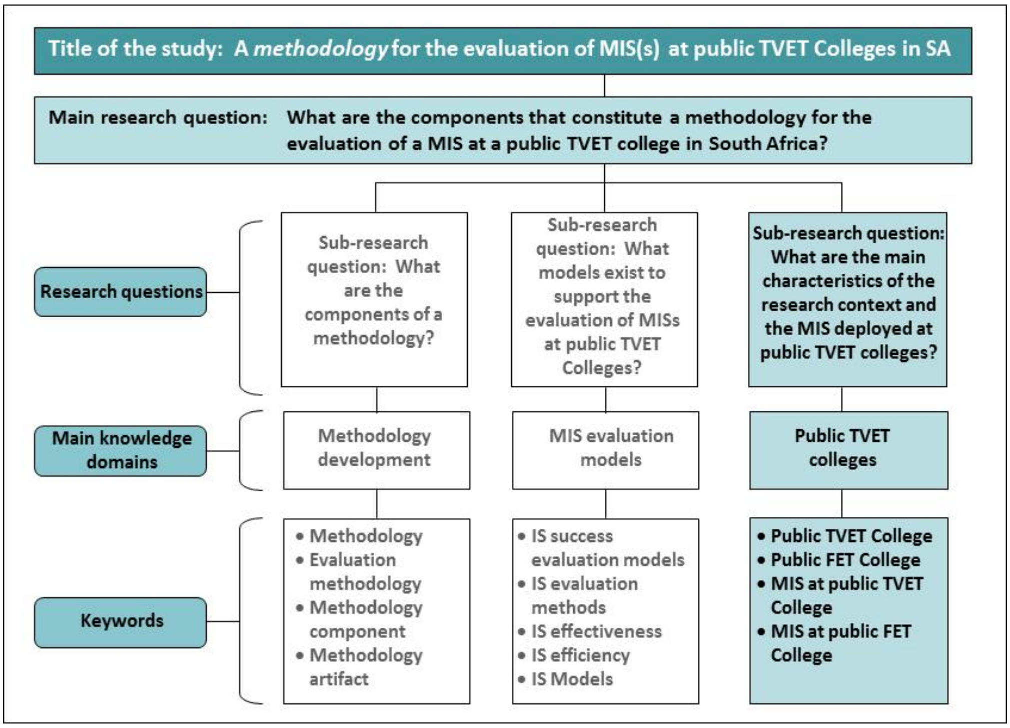


Figure 5.2. Framework for the systematic literature review of the study.

Literature review techniques, as defined and explained in Table 1.1, were utilised to explore the knowledge domain further. Table 5.1 provides information on the structured approach that was followed in conducting the systematic literature overview for this chapter through which the initial sources were collected. A selected number of the total number of resources found on keyword searches was suitable for referencing.

Table 5.1. Results of the systematic literature overview to indicate scope. Adapted from Levy and Ellis (2006), and Webster and Watson (2002).

Key word:	Number of literature resources found by database:		
	Google Scholar	JSTOR	ProQuest
Public TVET College	4 880	24	826
Public FET College	22 600	2 038	7 257
MIS at public TVET College	356	81 162	47
MIS at public FET College	7 260	83 744	4

ABI/INFORM™ database Keyword	Search criteria	Results: (Number of related articles)
TVET College	All (Technical and Vocational Education and Training College); full-text; peer reviewed; all dates.	4 500
MIS at TVET College	All (Technical and Vocational Education and Training College) AND All (Management Information System); full-text; peer reviewed; all dates.	2 976
FET College	All (Further Education and Training College); full-text; peer reviewed; all dates.	43 342
MIS at FET College	All (Further Education and Training College); full-text; peer reviewed; all dates.	27 250

Since public TVET Colleges are technical and vocational education and training institutions, other platforms on which literature searches were launched were sites of administrative management of the colleges and academic and research institutes where studies, focusing on aspects of public TVET Colleges in South Africa, were conducted. The websites of the Department of Higher Education and Training (DHET); JET Educational Services; Further Education and Training Institute; Human Sciences Research Council (HSRC) and the official DHET TVET Colleges South Africa website (at http://www.tvetcolleges.co.za/default.aspx) were also identified as relevant sites containing valuable information about TVET Colleges in South Africa.

Experts on the South African TVET research and practice field were identified through literature reviews and include the following researchers and practitioners: Professor Simon McGrath (University of Nottingham, United Kingdom); Professor Volker Wedekind, associate professor and research chair in Vocational Education and Pedagogy in the Centre for Research in Education and Labour (REAL) in the Wits School of Education, University of the Witwatersrand; Dr Joy Papier (Further Education and Training Institute, University of the Western Cape, http://www.feti.ac.za); Seamus Needham (Further Education and Training Institute, University of the Western Cape, http://www.feti.ac.za); Dr Anthony Gewer at JET Educational Services (http://www.jet.org.za); researchers at the Human Sciences Research Council (HSRC), especially researchers who conducted research through the Labour Market Intelligence Partnership programme (www.lmip.org.za) and managers of the TVET sector at the Department of Higher Education and Training, Technical and Vocational Education and Training Branch (http://www.dhet.gov.za).

The following section provides background to the TVET College sector.

5.3. Background to the TVET sector

The TVET sector is defined by the United Nations Educational, Scientific and Cultural Organisation (UNESCO) as "a comprehensive term referring to those aspects of the educational process involving, in addition to general education: the study of technologies and related sciences; as well as the acquisition of practical skills, attitudes, understanding, knowledge relating to occupations in various sectors of economic and social life" (del Mar, 2011, p. 4).

The TVET sector is furthermore understood to be "an integral part of general education; a means of preparing for occupational fields and for effective participation in the world of work; an aspect of lifelong learning and a preparation for responsible citizenship; an instrument for promoting environmentally sound sustainable development (Greening TVET International Framework); and a method of facilitating poverty alleviation" (del Mar, 2011, p. 4).

5.3.1. Overview of public TVET Colleges in South Africa

Public TVET Colleges in South Africa were formerly known as Technical Colleges which were merged, in a process that concluded in 2006, into public Further Education and Training (FET) Colleges and then renamed in 2013/14 as public Technical and Vocational Education and Training Colleges (DHET, 2014). Public TVET Colleges were established and operate under the authority of the Further Education and Training (FET) Act No. 16 of 2006 (which was also renamed to Continuing Education and Training Act No. 16 of 2006) and they are subject to the authority of the Department of Higher Education and Training (DHET) (DHET, 2014).

The college sector is seen as central to the provision of post-school education and training in South Africa, and strengthening and expanding this sector is one of the DHET's highest priorities. A number of areas require strengthening at the colleges, including the improvement and development of information systems (DHET, 2014). Colleges are registered at the DHET and offer programmes such as the National Certificate Vocational (NC[V]) and the National Accredited

Technical Education Diploma (NATED) that are accredited by the DHET. Some of the colleges also offer programmes that are accredited by the Education and Training Quality Assurance (ETQA) of the Sector Education and Training Authorities (SETAs) and by the Quality Council for Trades and Occupations (QCTO). The public TVET Colleges have become important providers of occupational learning programmes funded by Sector Education and Training Authorities (SETAs) in terms of the SETA Grant Regulations. In addition, public TVET Colleges are also phasing in the offering of Higher Certificate programmes on NQF level 5 in collaboration with Higher Education Institutions (HEIs). One of the DHET's central strategic objectives for the public TVET College sector is the need to increase access to, and improve, success in programmes that lead to intermediate and high-level learning (DHET, 2016b).

Public TVET Colleges are subsidised by the state. Each of the country's nine provinces has an office that provides specialised professional support to public TVET Colleges in that province. The student headcount enrolment increased with 144% from 302 550 in 1998 to 737 880 in 2015 (DHET, 2006, 2015, 2016b, 2017).

There are 50 registered and accredited public TVET Colleges in South Africa which operate on more than 264 campuses in both rural and urban areas of the country. The colleges are provincially spread as follows: KwaZulu-Natal has the highest number of nine public TVET Colleges; the Eastern Cape and Gauteng both have eight; Limpopo has seven; the Western Cape has six; the Free State has four; Mpumalanga and the North West province both have three and the Northern Cape has the lowest number of two (TVET Colleges South Africa, 2015).

It is furthermore evident from government planning and policy documents that the success of the public TVET College system is paramount for reaching their goals in equipping the youth to become more employable and making TVET Colleges, institutions of choice. Evidence of government's intent can be found in the following key documents:

- Our Future – make it work: National Development Plan 2030 (NPC, 2013)
- 2010/11 – 2014/15 Strategic Plan Revised version: March 2012 (DHET, 2012a)
- White paper on post-school education and training (DHET, 2014)
- National Plan for Further Education and Training Colleges in South Africa (DoE, 2008)
- The new growth path: The framework (Government of SA, 2010)
- The new growth path: Accord 1, National Skills Accord (EDD, 2010)
- Industrial policy action plan 2012/13 - 2014/15 (DTi, 2012)
- Human Resource Development Strategy for SA (HRD-SA) 2010 – 2030 (Government of SA, 2009)
- Towards 2018: South Africa's ten-year national innovation plan (DST, 2007).

Much is expected of the TVET College sector. The DHET earmarked the public TVET College sector to provide the intermediate-level and artisanal skills to mitigate the critical shortage of people to fill positions available in the technicians and associated professionals' occupational category and thereby massively alleviate unemployment in South Africa (Cosser, 2012).

5.3.2. Investment and Interventions

In April 2005, the allocation of R1.9 billion for the re-capitalisation of public TVET Colleges for the period 2006/7 to 2008/9 was announced. Of this amount, R50 million was allocated to planning requirements necessary for the re-capitalisation of the 50 colleges. The achievements of government through the re-capitalisation grant are listed below (DHET, 2012a).

- A number of 18 455 lecturing and support staff received training over this period. It has been reported that public TVET Colleges employed 18 235 staff (including management, lecturing and support staff) in 2015 (DHET, 2016b, p. 34, 2017).

- Extensive Information Technology (IT) infrastructure was introduced. Norms and standards for all IT equipment, software and architecture were developed and utilised throughout the sector to ensure that the IT expenditure would be aligned to the Connectivity Programme.
- Over a period of three years the LAN and WAN of 201 of the 267 campuses were upgraded.
- Large-scale upgrading, refurbishment, alteration and modernisation of workshops, classrooms, laboratories and offices while new workshops, resource centres, laboratories, offices and classrooms were built where this was necessary.
- The policy on the National Certificate (Vocational) (NC[V]) qualification and the related curriculum policy framework was gazetted in March 2006.
- In July 2006, after a lengthy process of consultation with government, industry, professional bodies, South African Qualification Authority (SAQA) and Umalusi, the subject and assessment guidelines for the initial 11 priority programmes of the NC(V) were finalised.
- In 2007, the government introduced a TVET College Bursary Scheme, administered by the National Student Financial Aid Scheme (NSFAS).
- In 2009 the policy which sets out the minimum admission requirements for the Higher Certificate, Diploma and Degree studies requiring the NC(V) Level 4 was gazetted.
- In 2010 the Minister re-instated the National Technical Education Diploma (NATED), Report 191 programmes with N1-N3 being mainly on engineering studies and artisan development.
- The extension of N4-N6 programmes (NATED, Report 191) to cater for those learners who completed Grade 12 was announced by the Minister.
- By 2010, Government had spent just under R1-billion, which benefitted 172 706 students from poor and working-class households by facilitating their access to education and training opportunities in TVET Colleges.

A comprehensive Turnaround Strategy for the 50 public TVET Colleges, including their 264 campuses, was furthermore developed and implemented. DHET’s intention with the strategy was to systematically address key challenges and to achieve sustainable improvements in the quality of teaching and learning. The envisaged goal of the strategy was to have TVET Colleges in their rightful place, contributing to driving South Africa's economy and thereby reducing unemployment, especially among the youth (aged 15 to 34 years) (Government of SA, 2012). The Turnaround Strategy aimed to address challenges such as the lack of ability to generate and manage reliable data which plagued the majority of TVET Colleges. In addressing the challenges, one of the principles in the DHET's strategy was *accountability for performance*. No change can be guaranteed unless accountability is assured. Therefore, it is important to be able to evaluate the success of systems such as the MIS(s) in terms of its role in providing reliable, accurate and quality data and information.

Financial support to colleges has grown significantly. State funding has increased from R3.8 billion in 2010/11 to R6.2 billion in 2015/16, representing a 63% increase (Government of SA, 2012; Joubert, 2015). There has furthermore been an increase in the TVET Colleges' bursary allocation from, R318 million in 2010 to R2.2 billion in 2015/16, representing an increase of 592% for the period. Increased financial support was possible through a combination of the funding sources of the state and of the skills levy system (Government of SA, 2012; Joubert, 2015).

Twelve new TVET College campuses in different parts of the country are in the process of being built. All fifty existing TVET Colleges have shifted from being a provincial to a national competence, making it easy for the DHET to manage them effectively. Sector Education and Training Authorities (SETAs) have been requested to open offices in TVET Colleges, mainly to facilitate work placement of students. By 2014, more than forty SETA offices had been opened in various TVET Colleges (Nzimande, 2014).

5.3.3. Waves of changes in public TVET Colleges

The landscape of public TVET Colleges in South Africa has been in a constant state of flux for the last two decades, as discussed in the previous section and illustrated in Figure 5.3. Accordingly, this necessitates the continuous changing, extension and adaptation of infrastructure including the MISs deployed at these institutions. MISs are pivotal to the efficient and effective running of any modern business, organisation or institution, including public TVET Colleges (Irani & Love, 2008a). Apart from an extant MIS, it is also accepted that one of the key factors for successful IS planning and implementation is a close link between IS strategy and business strategy (Baets, 1992; Atkins, 1994; Paterson, 2005).

Despite the many changes with the intention to develop and improve the quality and efficiency of the colleges, including the throughput rates of students, they are still underperforming and the implemented interventions do not seem to be having a major effect (Pote, 2014; Kraak, Paterson & Boka, 2016).

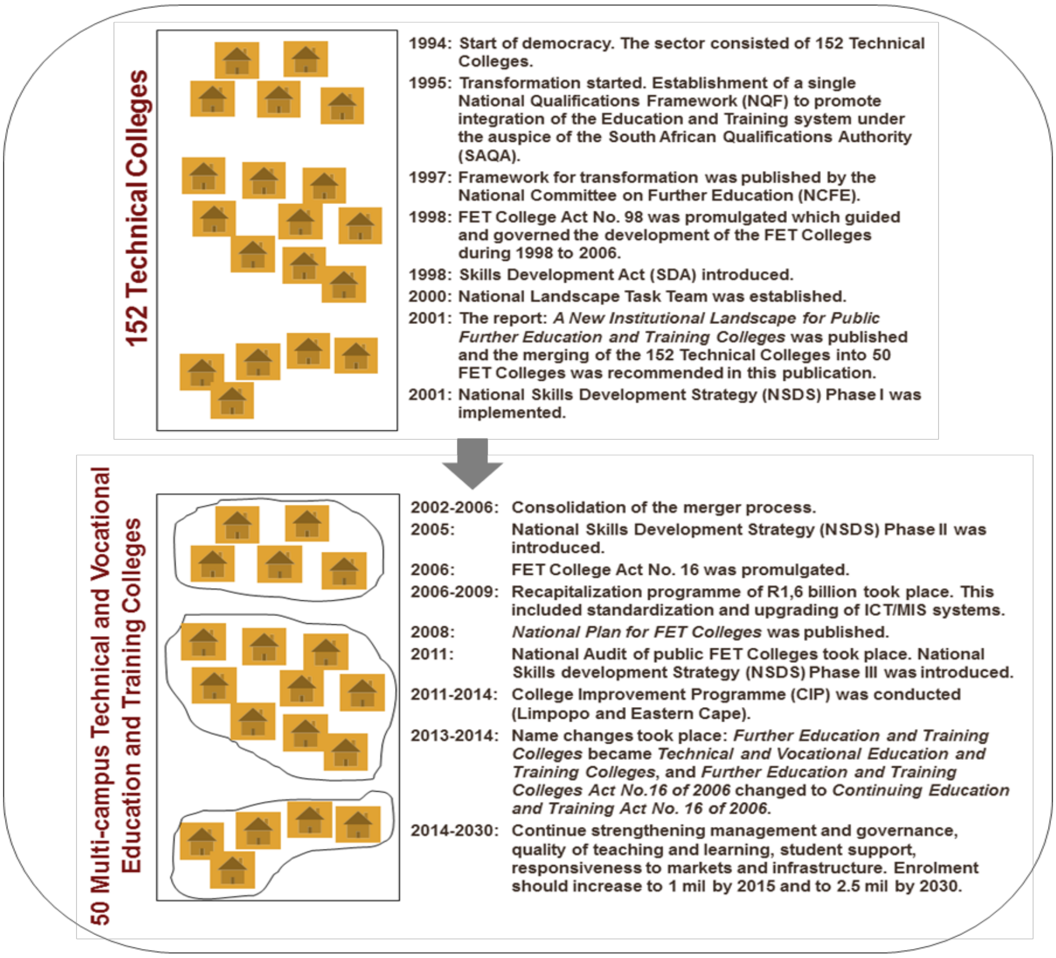


Figure 5.3. Overview of the changes in the public TVET sector since 1994.

Paterson (2016, p. x) presents a metaphor to illustrate the twenty years of restructuring in the TVET sector by comparing changes in programmes, policies, or projects aimed at bringing about change in the colleges to the "physics of ocean waves" and describe the process as follows:

> Waves work on the ocean floor and coastline to reshape it, while simultaneously the ocean floor and coastline contain and influence the work of the waves. Out of this interaction, the shoreline may be transformed. However, waves do not travel in exactly straight lines and do not arrive at the shore in a straight line, just as a wave of institutional change does not arrive at exactly the same time or work evenly on each institution. In a fluid environment, it is possible for waves to move at different speeds, causing some waves to slow down and allow following waves to catch up. This movement increases the amount of energy that is expended, intensifying the impact of the waves on the sea shore. In the colleges, some waves of change slowed down while others caught up with them, testing the ability of the colleges to cope with the combined impact. Waves respond differently, depending on the shape and characteristics of the sea shore, providing an analogy for how waves of change impact differently, depending on the particular conditions in each college. Finally, when waves begin impacting on the shoreline, they travel at different speeds and in different directions, leading to interference and turbulence which features unpredictable changes. This property of waves is analogous with how interventions may interfere with each other, causing a reduction in effectiveness (Paterson, 2016, p. x).

It is also noted that too many changes condensed into too short a time could have put the absorptive capacity of the public TVET Colleges under severe pressure and could ultimately become counterproductive (Paterson, 2016).

5.3.4. Headcount enrolments

Figure 5.4 provides the number of students (headcount) enrolled in public TVET Colleges from 1998 to 2015. The available data based on the headcounts show that the growth between 1998 and 2015 was 144%.

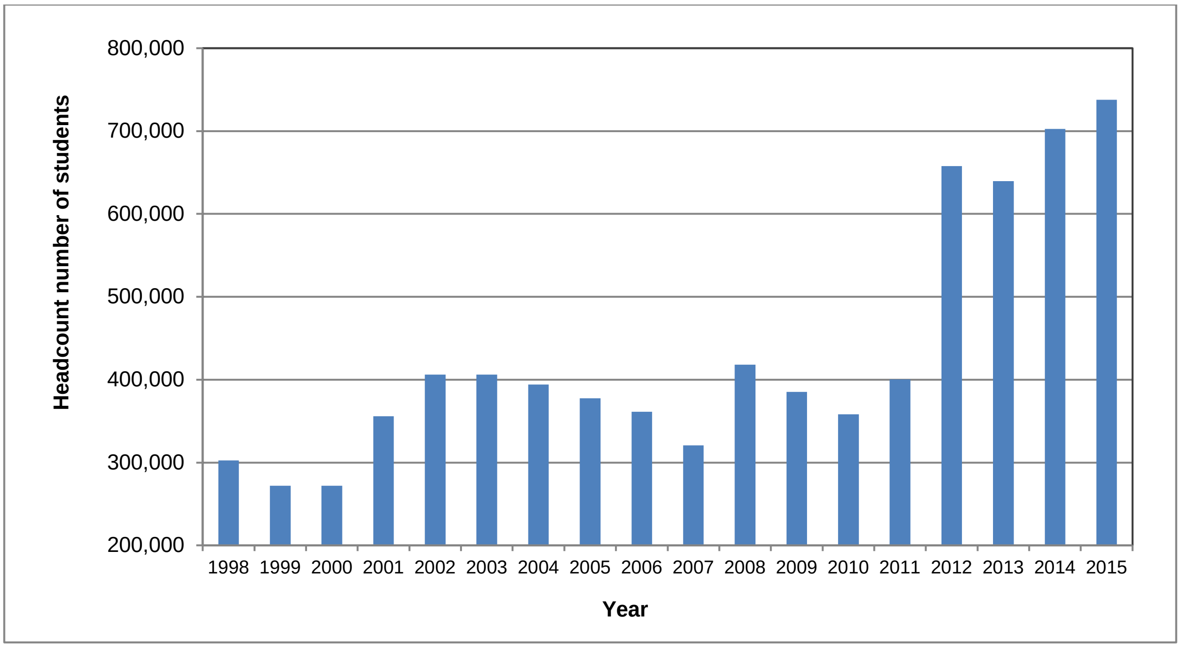


Figure 5.4. Headcount number of students enrolled in public TVET Colleges, 1998 to 2015.

Generated by author using sources: National Department of Education, 1998-2006; (ETDP SETA, 2012:10)*, Statistics on Post-school Education and Training in South Africa: 2015* (DHET, 2017).

There was a 29% increase in enrolment from 2010 to 2011 resulting from the NATED programmes being reintroduced into TVET Colleges and from learnerships and other skills programmes. The number of students grew from 400 273 in 2011 to 657 690 in 2012. These figures include students in state-funded (NC[V] and Report 191 programmes), as well as Occupational Programmes. This represents a 64% increase in headcounts over two years. The significant growth in occupational enrolments of 84% is attributed to increased use of the colleges for training, which is funded by the National Skills Fund (NSF) and Sector Education and Training Authorities (SETAs) (ETDP SETA, 2012). It was anticipated that enrolment would rise slightly in 2013 and then stabilise for a while as the structural alignment of colleges and SETAs take further effect (ETDP SETA, 2012).

Over a six year period, from 2010 to 2015, an increasing trend has been observed in the number of students enrolling for N1-N6 programmes (Report 191). The majority of public TVET College students enrolled in these programmes throughout the period 2010 to 2015. Between 2010 and 2015, a growth of 206% (from 169 774 to 519 464) was recorded in the number of enrolments for Report 191. NC(V) enrolments were the second largest but there has been a steady growth in the past six years, with 2015 enrolment 0.6% lower compared to 2014, and 27.2% higher compared to 2010. Low enrolments were recorded for occupational qualifications and other skills development and short courses over the period 2010 to 2015 (DHET, 2017).

Further expansion in the TVET College sector is envisioned. The White Paper on Post School Education and Training sets a target of 4 million enrolments in TVET Colleges and other non-university post-school institutions by 2030 (DHET, 2014). The National Plan for TVET Colleges had a target of 1 million enrolments by 2014 (DoE, 2008). The Framework of the New Economic Growth Path aims to enhance growth, employment creation and equity in the country (Government of SA, 2010). The policy's primary target is to create five million jobs over a period of 10 years. One of the strategies proposed to enable South Africa to grow in a more equitable and inclusive manner involves public TVET Colleges. Both the New Growth Path and the White Paper on post-school education and training emphasise that for the TVET College sector to be effective, graduation rates must rise significantly (Government of SA, 2010; DHET, 2014).

The National Development Plan (NDP) 2030 states that the TVET College system is not effective (NPC, 2011). The NDP 2030 informs that the college system is too small and the success rate is extremely low (NPC, 2011). Continuous quality improvement is needed as the system expands and courses need urgent revision in terms of their quality and relevance. Demand for TVET services will automatically increase when quality improves and the employability of graduates increase. Simply growing the sector without focusing on quality is likely to be expensive and demoralising for young people, and will cause further stigmatising of the system (NPC, 2011). Another challenge for the TVET College sector is the fragmentation of their data systems which leads to poor planning and the lack of reliable information (NPC, 2011). Bottema (2014) notes that TVET Colleges have to work smarter. Bottema (2014) also emphasises that

TVET Colleges need tools that will enable them to see data visually and manage performance effectively by producing appropriate statistical indicators.

5.3.5. Strengthening of MIS

In addition, as explicitly stated in the White Paper for post-school education and training, central to strengthening the colleges as institutions is improved information for the support of management decision-making (DHET, 2014). The DHET proposes to substantially improve data collection and management at both national and college levels. This has direct implications for management information systems deployed at public TVET Colleges. Data and information requirements including: lecturer qualifications and competencies; financial status of colleges; student registration and assessment results; infrastructure and equipment, to determine capacity to deliver programmes and sub-system growth; student needs and support requirements; employer demand for vocational and occupational programmes are all key information requirements for the DHET and colleges (DHET, 2012b).

For a college to function at its best and to respond rapidly to such queries related to management it requires an MIS which operates efficiently and effectively. It is therefore important to evaluate the success of the MIS on a regular basis to enable system or content adjustments and thus enable the generation of appropriate drill-down, exception, demand, key-indicators and scheduled reports for effective and efficient management, when necessary.

5.4. Developments in colleges' data reporting systems

Management of information is one of the critical aspects of TVET Colleges' operational capacity. In an information age where the collection and storage of data are computerised, Information and Communication Technology (ICT) and Management Information Systems (MIS) are synonymous. In TVET Colleges the two are intricately linked where the MIS relies entirely on the ICT platform utilised at the college (Cosser, Kraak & Winnaar, 2011).

5.4.1. MISs deployed at public TVET Colleges

Prior to 1994, it was expected of the then so-called *Technical Colleges* to provide summarised data tables on headcount and full-time equivalent (FTE) student enrolment, numbers of staff and the programmes offered in a standardised format to their respective governing departments. No specific software applications for managing the colleges' internal data were prescribed by their governing departments – some colleges used paper-based systems while others used automated computer systems, varying in sophistication and hugely fragmented. Each technical college decided autonomously on the type of suitable and affordable system to use. This led to inconsistencies in the practices of technical colleges with regard to the type of internal MISs deployed (Visser, 2012).

The National Plan of 2008 emphasises the expansion and use of ICT as one of the priority areas (DoE, 2008). Indeed, one of the government's Apex Priorities was the speeding up of ICT interventions to provide cost-effective ICT platforms. This entailed increasing the use of broadband and other ICT by addressing infrastructure development, cost and other issues related to access to ICT. By using the Recapitalisation Conditional Grant, the then called Department of Education (DoE) took a decision in 2006 to equip all 50 colleges with modern ICT infrastructure. This included the installation of LAN and WAN to enable students, lecturers and management to access e-mail and the internet (cf. section 5.3.2 for progress on goals). The National Plan further entails that the DoE and the Provincial Departments of Education, in partnership with the Department of Communication, should continue to support colleges to build suitable connectivity infrastructure and to create access to quality vocational education through quality e-learning and distance education (DoE, 2008).

It was for this reason that, with the re-structuring process, the DoE decided to standardise ICT infrastructure and MISs at public TVET Colleges. Subsequently, a tender for the development of a MIS for public TVET Colleges was advertised and the company awarded the contract started implementing components of the Integrated Tertiary Software (ITS) at the DoE and three selected public TVET Colleges in 2006, as part of a pilot implementation phase (Interviewee 1, 2015).

Components of the ITS, which was referred to as the Business Management System (BMS), were implemented sequentially and were fully operational at the three pilot TVET Colleges in 2011. The DoE planned to expand the standard BMS to an additional four public FET Colleges by March 2012 (DHET, 2011). One of the main benefits of the BMS was that it was an internet-based system and was therefore directly linked to the DoE for quick updated strategic management and planning information, and indicator development to facilitate monitoring and evaluation of the TVET sector. Before the decision to extend the BMS (ITS system) to all colleges could be implemented and funded, the DoE split into the Department of Basic Education (DBE) and the DHET, and the management of the colleges migrated from the provinces to the DHET.

The Further Education and Training (FET) Audit, conducted in 2010, on computerised systems deployed at the then so-called public FET Colleges revealed that many different computer software products were used (Cosser, Kraak & Winnaar, 2011; Cosser, 2012; Visser, 2012). These include the following: BMS (Business Management System), COLTECH, ITS, DB2000, FETMIS, Pastel, IQUAL, VIP Payroll, MS Access, TRACTEC, BAUD and COLTSMS. The predominant product used by colleges was COLTECH (30 colleges or 60%), followed by DB2000 (13 colleges or 26%). Most of the colleges were using a combination of these products to facilitate different functions. For example, a college could use COLTECH for asset and finance management, and for student registration, but another product for human resources and personnel management (Cosser, Kraak & Winnaar, 2011).

Up to 2016, governing departments required public TVET Colleges to submit a predefined set of aggregated data tables in MS Excel on a regular basis which had to contain summarised information about student enrolment by programme offering, and information regarding student and staff demographics. The Technical and Vocational Education and Training branch, within the DHET responsible for TVET Colleges, developed three templates for data submission namely: the Annual Survey, Skills Accord and Weekly Record templates (Interviewee 1, 2015). Data from the MS Excel templates are then integrated at DHET. This is a manual and extremely labour intensive process which is susceptible to errors.

Data captured on these templates are used to report on progress with regard to national priority indicators such as: whether the enrolment growth target of 15% per annum was achieved; whether throughput and certification rates improved and whether an increased number of learners were placed for workplace exposure or workplace-based experience (Marock, Hazell & Akoobhai, 2016). The information is furthermore published in the department's annual reports and other statistical publications such as the *Statistics on Post-School Education and Training in South Africa*. This method of data gathering has many disadvantages and presents many challenges, for instance summarised tables on different characteristics or demographics of students and staff were not tallying correctly and because of the aggregated nature of the figures, it was not easy to correct anomalies. The original source needed to be consulted in order to clean and correct the data (Interviewee 1, 2015).

In the period just before 2016, colleges mainly utilised one of four systems: COLTECH, ITS (Integrated Tertiary Software), Thusanang or DB2000 for most of the management functions at the college. The ITS system is an international system which is also deployed in the university sector; COLTECH has been nationally developed specifically for the college sector by a private company in South Africa and the Thusanang system was developed by a lecturer at one of the TVET Colleges in South Africa (Interviewee 1, 2015). DB2000 withdrew from the TVET College sector in 2015 and forced a quarter of the colleges to migrate to another available system. Most of the colleges that were using DB2000 migrated to ITS. In 2016, three different MIS systems were deployed at public TVET Colleges: more than half (54% or 27 colleges) made use of the COLTECH system, just less than half (42% or 21 colleges) utilised the ITS and two colleges used the Thusanang system for most of the business functions at the college. One of the colleges that was using the Thusanang system was in the process of migrating to the ITS system as from early 2016 (Interviewee 2, 2015).

MIS usage tends to be provincially determined. For example, in the Free State and KwaZulu-Natal all colleges are using the COLTECH system and the North West province uses ITS. In Gauteng, half of the colleges are using the ITS system, while the other half are using other systems. Six of the eight colleges in the Eastern Cape are utilising the ITS, while six of the seven colleges in Limpopo are using the COLTECH system and five of the six colleges in the Western Cape are utilising the ITS system.

More detailed information about these MISs is provided in the next section.

5.4.1.1. COLTECH system

The COLTECH Windows System is a management information system for TVET Colleges. The system is designed to run on either a Local Area Network (LAN) or a Wide Area Network (WAN) and can handle the versatility of multi-campus colleges (COLTECH, 2016). Some of the public TVET Colleges have been using the system for many years, even prior to 1994. Figure 5.5 is an illustration of the products offered by COLTECH on its website. The website lists the following products: Coltech Student System; Coltech Finance System; Coltech Staff Management System; Coltech Fixed Assets System; Coltech Library System; Coltech Dashboard; and Coltech Student Portal with web pre-enrolment; and more Coltech features.

COLTECH describes itself as having been established in 1990 to provide training to staff members of technical colleges (COLTECH, 2016). In June 1991, COLTECH bought an administration system, including all rights, which has been used by five colleges since 1990. This system was revamped, and reference manuals and training manuals were written, leading to the implementation of the first COLTECH system in June 1992. Between 1992 and 2000 the number of users increased to more than 110 technical colleges, community colleges and schools. Currently, a majority of 27 public TVET

Colleges (technical colleges were merged into TVET Colleges) are using the COLTECH system.

The following were used to comply with the development of the COLTECH MIS (COLTECH, 2011):

- The COLTECH system is a client server product that can handle the vast number of information needs in a multi-campus environment.
- The COLTECH system runs on a Terminal Server network, which means that data from all the campuses is shared or centralised on one server via WAN.
- One student number range is used to allocate a unique number for a student, but the campus code is included in this number. This makes it easy to differentiate from which campus the student originally enrolled.
- Student and Financial data is stored according to campus codes and can therefore give a summary or combined result of financial information.
- Courses of the total TVET spectrum can be used with COLTECH.
  - Trimester, Semester and Year NATED Formal courses;
  - SAQA courses with Unit Standards and lecturer assessments;
  - Any other non-formal courses;
  - ABET courses;
  - HET courses.
- Different time periods (like trimester, semester, etc.) can be set up for each campus.
- All COLTECH Systems include a user management console, which provides for login names, password and access rights in each system. These access rights are on various levels ranging from administrator, supervisor, financial user, or user.
- COLTECH uses the CT-Net infrastructure to support the COLTECH users on-line, free of charge. On-line programme updates and backup services are also supported.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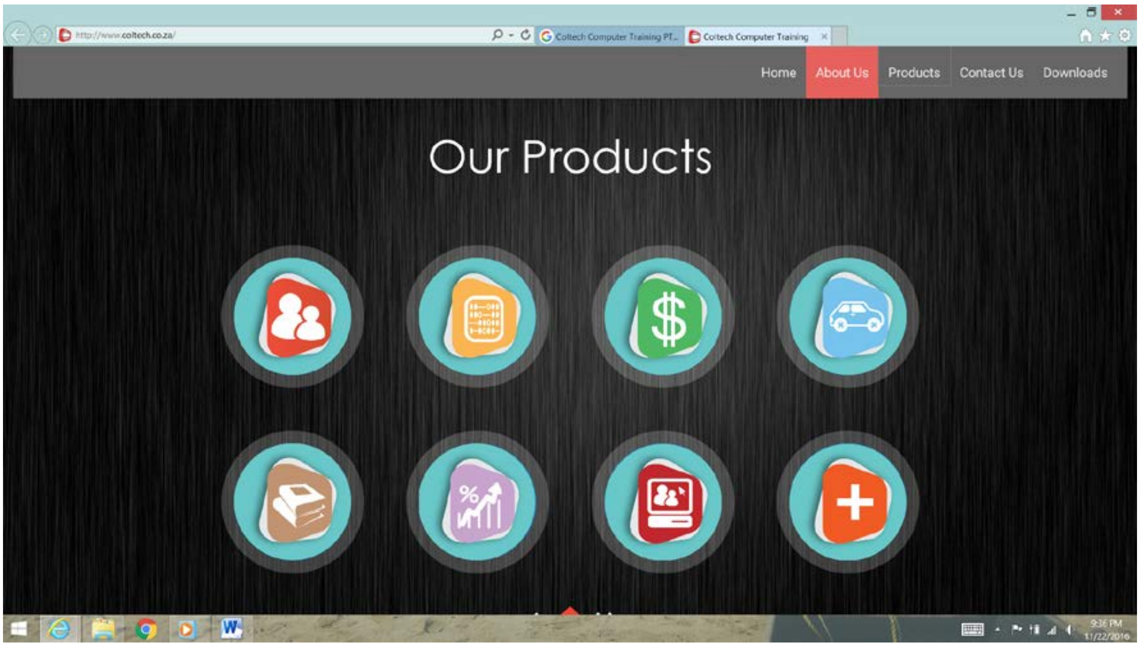
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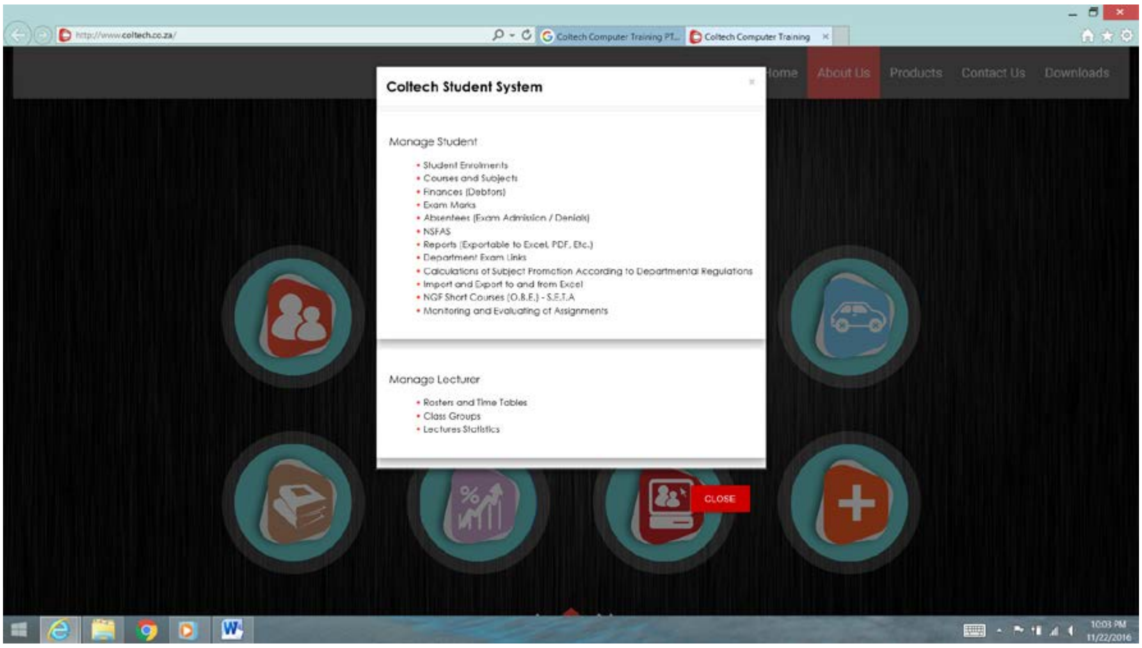


Figure 5.5. Screen shots of the COLTECH computer training website (COLTECH, 2016).

5.4.1.2. Integrated Tertiary Software (ITS)

Integrated Tertiary Software (Pty) Ltd (ITS) represents the software component of the company, Adapt IT. Adapt IT is an innovative information technology (IT) service and specialised solutions provider. The company has been in operation for more than 30 years, and delivers IT solutions to manufacturing, financial services, education and energy organisations in over 38 countries and more than 52 education institutions worldwide. The ITS was established in 1986 and is the only African provider of Enterprise Resource Planning (ERP) software to support all administrative requirements of tertiary education institutions. It includes functionality to support the management of students, student billing, financial, human resources, payroll, facilities, MISs including library services. Statutory information, including the management of student marks in conjunction with the DHET, is also provided by the system (Adapt IT, 2016; iTS holdings, 2016).

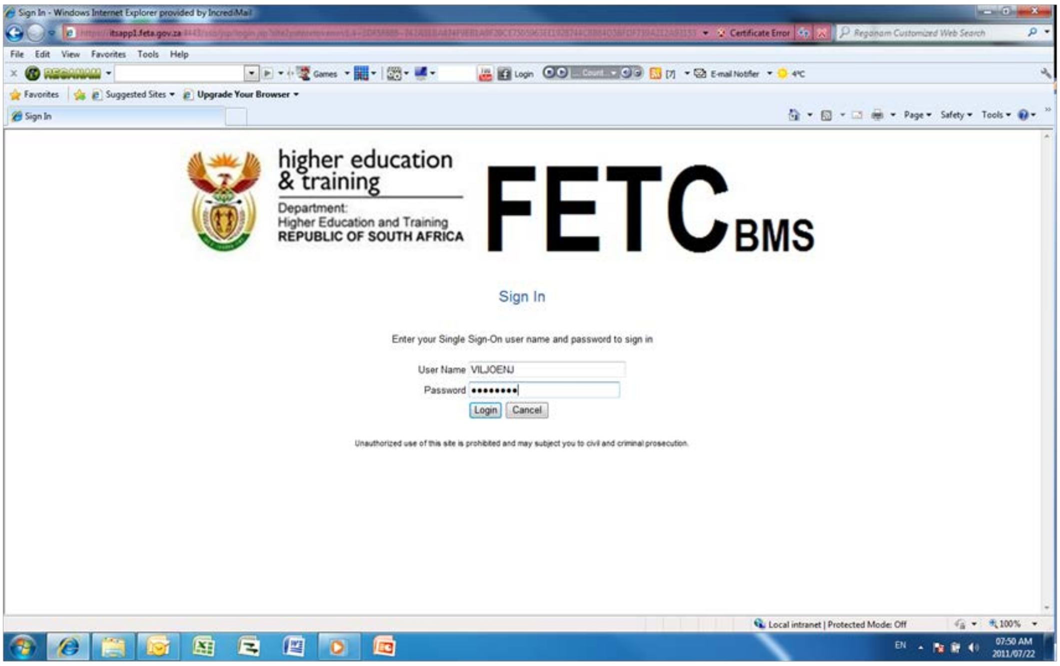
The current client base includes Higher Education, TVET Colleges and training institutions in, for example, South Africa, Ireland, Namibia, Botswana, Swaziland, Rwanda, New Zealand and Bolivia. Membership of the ITS User Group is open to all organisations and institutions utilising the Integrated

Tertiary Software (Pty) Ltd administrative systems (Adapt IT, 2016; iTS holdings, 2016).

Integrated Tertiary Software (ITS) was accredited with Proudly South African status in 2003. The software is deployed on a central server, with each campus linked to the server. Data are managed on campus level, while the system architecture allows for reporting on campus and college level (Adapt IT, 2016; iTS holdings, 2016).

The ITS system can be purchased and implemented modularly to assist institutions to implement core modules in the initial phase, with the option of adding new system modules as, and when, needed. All system modules are fully integrated and web-enabled. Strategic statistical and management information can be extracted on an ad hoc basis by utilising end-user query tools in conjunction with specially created ITS views of the database. The company offers a wide range of related training, support database administration and consultation services to facilitate the transfer of knowledge to staff members at client institutions (Adapt IT, 2016; iTS holdings, 2016).

Figure 5.6 contains screen shots of some of the screen displays of the ITS system.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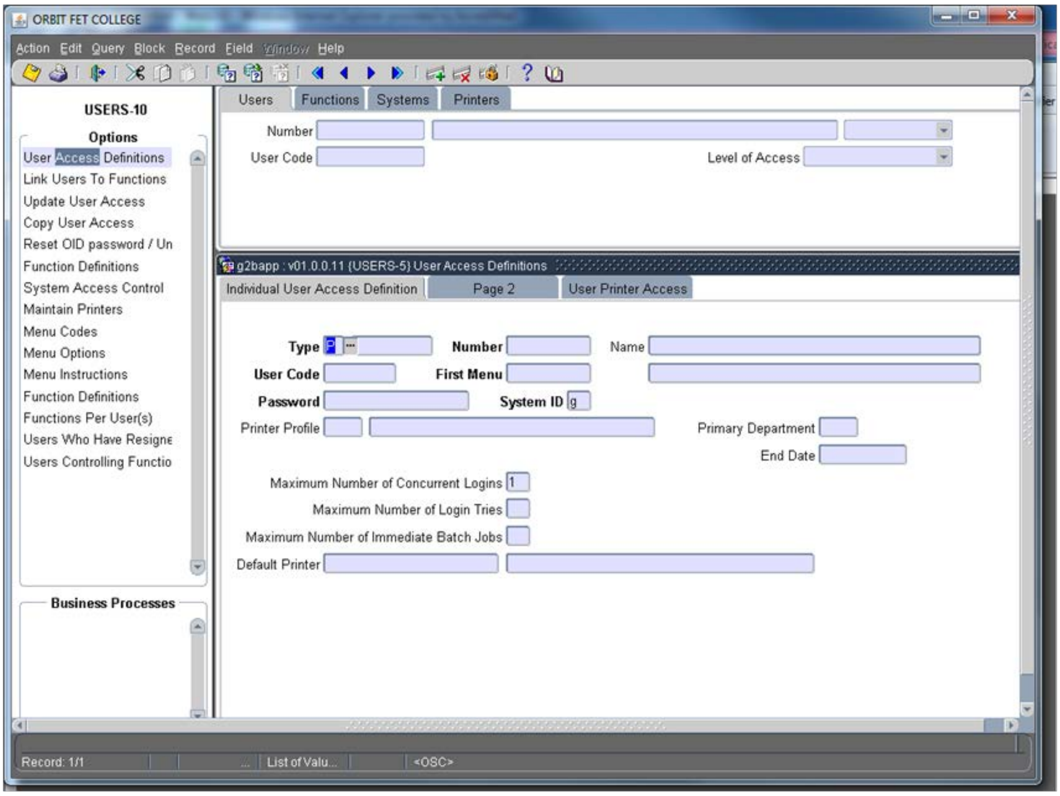
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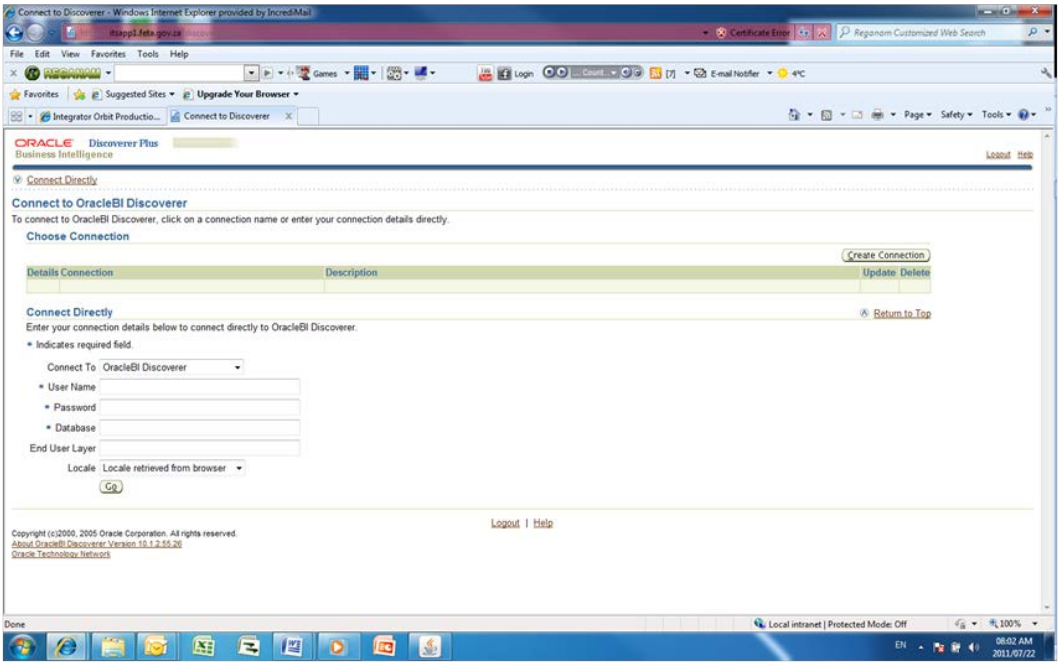


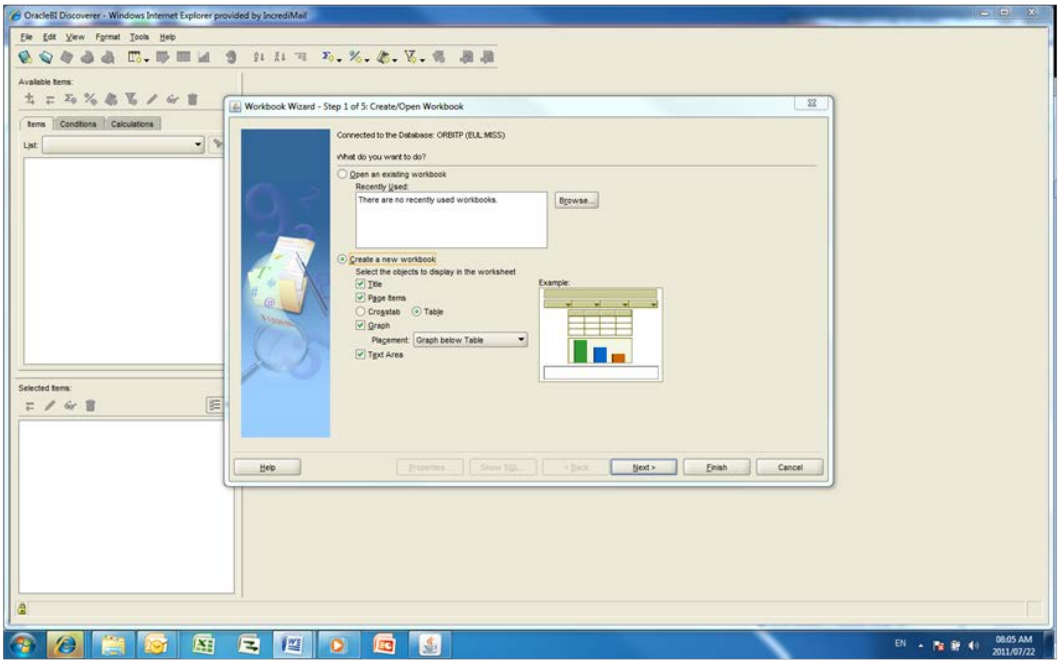


Figure 5.6. Screen shots of the ITS system (Visser, 2012).

5.4.1.3. Thusanang system

The word, Thusanang, is an African word which means ‘we build together’. The system was developed by a lecturer employed by Sedibeng TVET College - one of the public TVET Colleges in South Africa. The system is uncomplicated but comprehensive, affordable and easy to use. Training is provided but the system is easy to understand and can be operated by any staff member without requiring formal training. The system comprises of the following components: student registration; human resource management; financial, asset and facility management; placement of students in industry and management of national examination results. The system communicates well with national systems such as national examinations. Files from national examinations can be uploaded and extensively queried without additional costs, because college staff can conduct queries themselves. At the college level, administrators usually capture all data onto the system - such as test marks and attendance registers. The utilisation of this system is becoming limited with only one college using the system by 2016. The only risk associated with the system is the fact that one person (the developer and owner of the system), who is approaching retirement, is responsible for maintaining and updating the system and owns all property rights.

5.4.2. Background to the TVETMIS system

Instead of prescribing the use of one standardised MIS at public TVET Colleges, the DHET set minimum data requirement standards and standardised the format in which colleges have to submit their data. An innovative system called the Technical and Vocational Education and Training Management Information System (TVETMIS) was developed by DHET and gradually implemented at the DHET. The TVETMIS is a unit record based information system that stores and maintains unit records of TVET College data related to the colleges and their campuses, programmes, subjects, staff and students. The system went live in the beginning of 2016 and is currently in the testing phase. The DHET constructed and developed data submission specification documentation for TVET Colleges in order to standardise outputs from college MISs for uploading to the TVETMIS (DHET, 2013; Interviewee 1, 2015).

These output files are referred to as *load files* to be uploaded to the TVETMIS. Comprehensive documents containing instructions and specifications to assist and support TVET Colleges to prepare their data files for the TVETMIS are available at https://webapps.dhet.gov.za/TECHNICA.aspx.

The data content of TVETMIS is primarily maintained and supplied by TVET Colleges. The TVET Colleges create electronic data submission files in standard formats and transmit them to the DHET to be loaded into TVETMIS. The purpose of the specification documentation is to provide TVET Colleges with a description of the standard layout, content and business rules for the submission of data to TVETMIS (DHET, 2013). All data submissions must be validated using the data validation utility distributed by DHET to all TVET Colleges. The data validation utility prepares the data submission in a predetermined format, as required for loading into the TVETMIS system. Thereafter the data validation utility allows the user to submit the data submission to the TVETMIS. Colleges are also provided with a list of data submission dates (DHET, 2013).

The implementation of the TVETMIS is an enormous development in the life of the TVET sector and will definitively contribute to enhanced quality and availability of data on public TVET Colleges. The success of TVETMIS relies heavily on internet access and connectivity – all colleges have connectivity but not all colleges have adequate connectivity.

5.5. Conclusion

This chapter focused on the third sub-research question in support of the main research question of the study namely: *What are the main characteristics of the research context and the MIS deployed at public TVET Colleges?* (cf. section 1.2.3.4). The historical background in terms of the college sector and the development of the data collection and information management systems, provides support for the relevance of the research problem and it also informs the development of the components, *Phase A: Principles*, *Phase B: Guidelines, practices and rules* and *Phase C: Procedures* of the conceptual framework of the TVET-MIS-EVAL methodology as presented in Chapter 3 (cf. Table 3.4).

It is evident that effective use of ICT at colleges, regardless of the name or type of system, hinges on e-mail connectivity, internet access, inter-campus connectivity, college-DHET communication, web-site management, use of ICT in the teaching and learning process and in student support and ICT support and maintenance.

Credible, accurate and reliable student data and information are imperative for the success of the college sector in terms of planning, monitoring and evaluation of the system, the position with regards to national targets and return on investment. The college sector has come a long way in eventually reaching the ideal of collecting unit record data in 2016 which, it is envisaged, will boost the quality of data and information on public TVET Colleges.

Based on the information presented in this and the preceding chapters, the next chapter will present the design, development and construction of the TVET-MIS-EVAL methodology (artefact) developed in this study.

CHAPTER 6. TVET-MIS-EVAL METHODOLOGY (ARTEFACT)

6.1. Introduction

This chapter presents the construction of the TVET-MIS-EVAL methodology.

The organisational problem, which initiated the need for this artefact as well as the motivation for its relevance, was presented in Chapter 1. The research design and methodology, as presented in Chapter 2, guided the design and development of the artefact, which is named the TVET-MIS-EVAL methodology.

The artefact is designed, developed and constructed in this chapter by using the knowledge building blocks gained through extensive literature reviews in the fields of:

- Methods, methodologies and paradigms, described in Chapter 3;
- Models utilised for success evaluation of MISs, presented in Chapter 4; and
- A description of the context of MISs deployed at public TVET Colleges in South Africa, provided in Chapter 5.

These chapters respectively addressed the first three sub-research questions (in support of the main research question) of the study namely:

- What are the components of a methodology? (cf. section 1.2.3.2),
- What models exist to support the success evaluation of MISs at public TVET Colleges? (cf. section 1.2.3.3),
- What are the main characteristics of the research context and the MIS deployed at public TVET Colleges? (cf. section 1.2.3.4).

It is important to remember that Chapters 3, 4 and 5 form part of the building process of the artefact. The output of Chapter 3 is a conceptual framework for the artefact and the outputs of Chapter 4 are firstly a conceptual model, and secondly effectiveness measures of MIS success evaluation constructs for inclusion in Phase C: Procedures and Phase D: Toolkit, which is part of the components of the artefact as presented in the conceptual framework of the artefact (cf. Table 3.4). Chapter 5 provides background to the context of a MIS under evaluation which informs the underpinning philosophical paradigm and guidelines of the artefact. Each of these chapters provides valuable substance for this chapter, in which the TVET-MIS-EVAL methodology (artefact) is constructed.

The content of this chapter represents the output of Phase 4 of the research process of the study which is underpinned by the third activity (*design and development*) of the DSRP model (Peffers *et al.*, 2006, p. 93), as depicted and shaded in Figure 6.1.

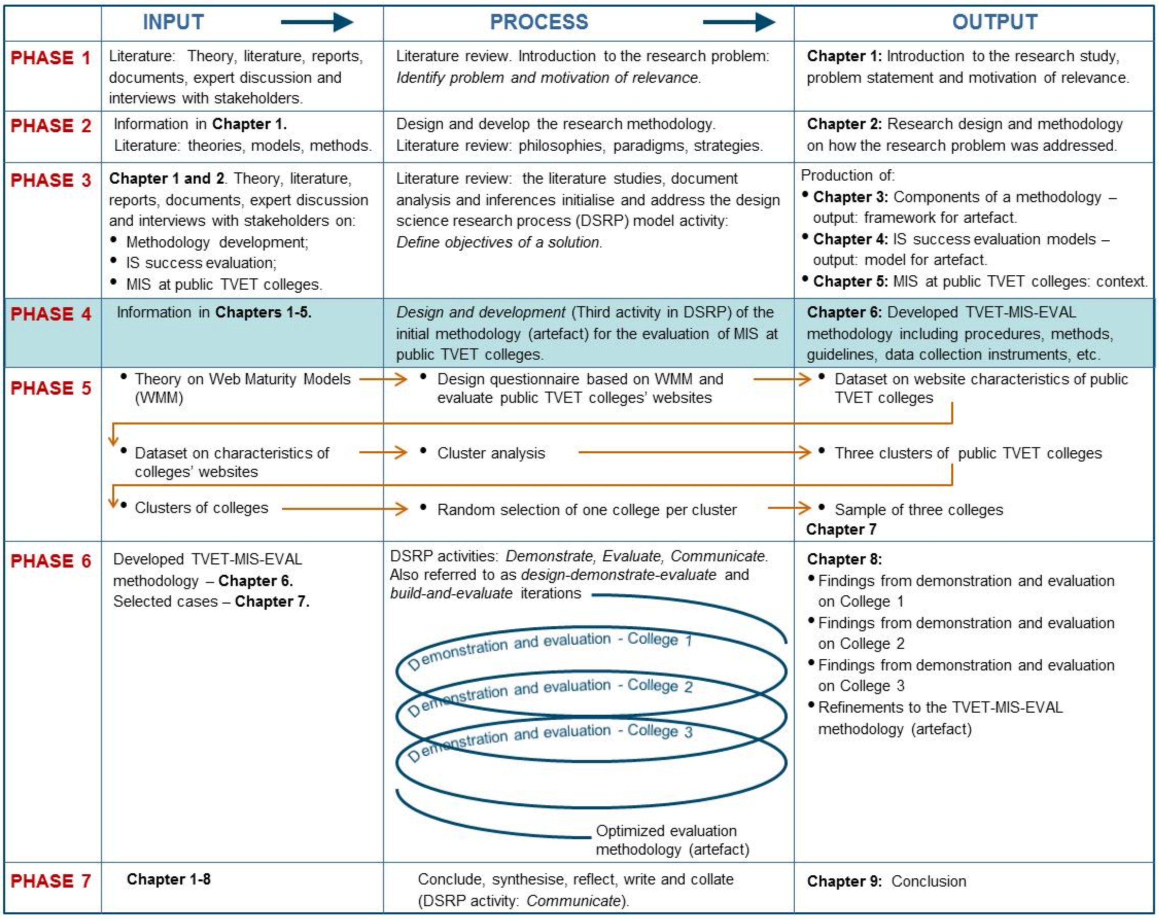


Figure 6.1. Research process of the study delineated by phases, inputs, activities and outputs, underpinned by the design science research process (DSRP) model (Peffers *et al.*, 2006, p. 93).

The chapter proceeds in section 6.2 with the philosophical assumptions of the artefact and is thereafter structured according to the components (phases) in the conceptual framework of the TVET-MIS-EVAL methodology as presented in Table 3.4.

It is important to keep in mind that a *methodology* comprises a philosophical paradigm which includes, as concluded in Chapter 3, section 3.5, a *philosophical* dimension with basic beliefs and assumptions about the world, and a *technical* dimension which incorporates the methods and techniques adopted when applying the artefact (methodology). Thus, a methodology represents the philosophical underpinning of a paradigm, as well as the methods and how they are used by this artefact (methodology) (McGregor & Murnane, 2010).

The following section presents the underpinning philosophical assumptions of the TVET-MIS-EVAL methodology.

6.2. Philosophical assumptions of the artefact

This section provides summarised information about the philosophical paradigm (the philosophy including the research approaches and procedures) which underpins the artefact.

6.2.1. Philosophy

Pragmatism is the philosophy adopted by the artefact itself. The focus in pragmatism is on practical application - theories or beliefs are evaluated to gauge how successful they are in practice. Philosophical assumptions and views of interpretivists and post-positivists are incorporated in Phase C: Procedures and Phase D: Toolkit of the artefact.

6.2.2. Research design and methodology

The artefact follows specific guidelines (Phase B: Guidelines, practices and rules) and makes use of questionnaires and interviews (Phase C: Procedures and Phase D: Toolkit) to evaluate the success of a MIS at a public TVET College in South Africa.

6.2.3. Approach

Both inductive and deductive approaches are used in the application of the artefact.

6.2.4. Research strategy

Qualitative data analysis by using data collected through semi-structured interviews and quantitative data analysis using data collected through a survey questionnaire are performed during the utilisation of the artefact.

6.2.5. Data collection techniques used

Primary and secondary data have to be collected during the application of the artefact. Information about the MIS, deployed at the college, has to be collected by using semi-structured and unstructured interviews with staff using the MIS in their daily working activities in the specific public TVET College and also by studying literature on the MIS under evaluation. Additionally, a survey questionnaire has to be administered to MIS users to elicit users' experiences and perceived satisfaction with different aspects of the MIS. These techniques will inform the evaluation of the MIS at the public TVET College.

6.2.6. Data analysis

Quantitative and qualitative data analysis techniques and triangulation of the results are used during the application of the TVET-MIS-EVAL methodology.

The remainder of the chapter will present and explicate the phases or components of the TVET-MIS-EVAL methodology.

6.3. The TVET-MIS-EVAL methodology

The artefact is based on the conceptual framework of components as presented in Chapter 3 (cf. section 3.5, Table 3.4) and informed by the DSRM suggested by Peffers *et al*. (2008, p. 54). The components of the TVET-MIS-EVAL methodology are briefly listed here and explicated in the following sections:

Phase A: Principles: The main principle of the TVET-MIS-EVAL methodology is defined in section 6.3.1.

Phase B: Guidelines, practices and rules: The developed guidelines for the TVET-MIS-EVAL methodology were informed by the guidelines for design science research (cf. section 6.3.2).

Phase C: Procedures: A conceptual process model for conducting success evaluation of MISs deployed at public TVET Colleges was identified and it satisfies the following objectives: it is consistent with prior literature; and it provides a nominal process model (cf. section 6.3.3).

Phase D: Toolkit: Models and methods for success evaluation of MIS at public TVET Colleges (cf. section 6.3.4).

Phase E: Standards and values: Initial standards and values were developed, and these will be extended and refined based on the outcome of the application of the TVET-MIS-EVAL methodology, on the three selected case studies (cf. section 6.3.5).

6.3.1. Phase A: Principles

The main principle of the TVET-MIS-EVAL methodology, within the information systems knowledge domain, is the success evaluation of MISs deployed at public TVET Colleges in South Africa, with an embedded goal of enhancing the functioning of an understood organisational problem, which is, how to evaluate the success of MISs at public TVET Colleges in South Africa. The philosophical assumptions of pragmatism, supported by interpretivist and post-positivist paradigms, underpin the application of the artefact. The artefact utilises a mixed-methods framework, which includes both quantitative and qualitative data collection and analysis methods and techniques.

6.3.2. Phase B: Guidelines, practices and rules

The set of guidelines, practices and rules, as suggested in Table 6.1, was developed for the TVET-MIS-EVAL methodology. The developed guidelines were informed by the guidelines for conducting and justification of design science research in IS proposed by Hevner *et al*. (2004) (cf. Table 2.3) as well as findings from the literature review on the context of public TVET Colleges (cf. Chapter 5). These rules provide guidance for conducting MIS success evaluation, in instances where the TVET-MIS-EVAL methodology is used.

Table 6.1. Guidelines for the application of the TVET-MIS-EVAL methodology informed by the guidelines for conducting design science research suggested by Hevner *et al*. (2004).

Guideline	Description
Guideline 1: Involve stakeholders	Stakeholders (e.g. college management and staff) should be involved in the process of MIS evaluation by informing them about objectives, outcomes, outputs, activities and other elements to ensure buy-in and ownership of endeavours to improve the MIS quality and functionality at the institution.
Guideline 2: Assess contextual data	Apart from a sole focus on the MIS under evaluation, the context and actors (contextual data) should also be assessed because this also influences achievement of results. The MISs of each institution should be understood on its own terms. Institutions possess different levels of organisational, managerial and information communication technology maturity and contextual factors should be reported on, and therefore also be taken into account in the evaluation process.
Guideline 3: Flexible application	Use the TVET-MIS-EVAL methodology and its components as a flexible application rather than a fixed map of evaluation. For instance, alternative data analysis methods could be used to analyse the data, as long as it utilises rigorous methods.
Guideline 4: Support to IT/ICT unit	The TVET-MIS-EVAL methodology provides an outline for evaluating MIS at public TVET Colleges; and the TVET-MIS-EVAL methodology enables the IT/ICT unit to achieve the following: • Translate its mandate into tangible results; • Support ongoing planning, management and monitoring functions; • Lay out objectives and priorities; • Support the measuring of MIS success; • Help demonstrate contributions to higher-level goals (e.g. data quality for reporting on targets set at national level by the DHET); and

Guideline	Description
	• Measure results on component level within the MIS utilised.
Guideline 5: Verifiable contribution	The effective application of the TVET-MIS-EVAL methodology must provide clear and verifiable contributions in the evaluation, outputs and outcomes of the evaluation.
Guideline 6: Research rigour	The TVET-MIS-EVAL methodology relies upon the application of rigorous methods in both the collection and analysis of data.
Guideline 7: Communication	The results and findings of the success evaluation, by using the TVET-MIS-EVAL methodology, must be presented effectively both to technology-oriented as well as management-oriented audiences.

6.3.3. Phase C: Procedures

This section presents descriptions of the procedures which include the processes utilised to conduct success evaluation of MIS at public TVET Colleges by using the TVET-MIS-EVAL methodology. According to Peffers *et al*. (2006) the designed conceptual process model should meet three objectives namely, it should:

- provide a nominal process for conducting IS research, i.e. a generally accepted mechanism for IS research which can be used as a roadmap;
- build on prior research; and
- be a mental or conceptual model which represents reality on a small scale.

The selected MIS success evaluation model for inclusion in the TVET-MIS-EVAL methodology, which was motivated in Chapter 4 section 4.8, and also presented in Figure 6.2, as well as the process model for the TVET-MIS-EVAL methodology, as presented in Figure 6.3, adheres to all these objectives.

6.3.3.1. Conceptual framework of the constructs within the TVET-MIS-EVAL methodology

The conceptual framework for Phase C: Procedures and Phase D: Toolkit, includes seven constructs namely: information quality, service quality, systems quality, end-user computing satisfaction model (which includes the constructs: content, accuracy, format, ease of use, timeliness), user satisfaction, individual and organisational impact (cf. Figure 6.2). All the identified constructs contribute to the success of the MIS under evaluation, and a holistic success evaluation of a MIS has to include the measuring of all of these constructs.

The constructs have been defined and described in Chapter 4, section 4.4, Table 4.3 and can briefly be summarised as follows:

- *System quality* refers to the quality of a system in terms of attributes such as ease of use, system flexibility, system reliability, ease of learning, including system features of intuitiveness, sophistication, flexibility and response times (Petter, DeLone & McLean, 2008; 2013).
- *Information quality* relates to the characteristics of systems' outputs, for example, accuracy, precision, reliability, format, volume, relevance, understandability, conciseness, completeness, currency, timeliness and usability, which are used in management reports and web pages (Wixom & Todd, 2005; Petter, DeLone & McLean, 2008; 2013).
- *Service quality* relates to aspects such as communication, relationship, attitude of support staff, vendor support, responsiveness, accuracy, reliability, technical competence and empathy of the staff. It refers to the quality of service or support which system users receive from the IT support staff (Petter, DeLone & McLean, 2008; 2013).
- *User satisfaction* refers to users' level of satisfaction with the MIS including the quality of information and reports, websites and support services (Bharati, 2003).
- The term *net benefits* includes the terms *organisational impact* and *individual impa*ct. *Organisational impact* represents the firm-level benefits received by an organisation because of MIS applications (Gorla, Somers & Wong, 2010), while *individual impact* is a measure of the extent to which the information system has influenced the capabilities and effectiveness of key users on behalf of the organisation (Gable, Sedara & Chan, 2008).

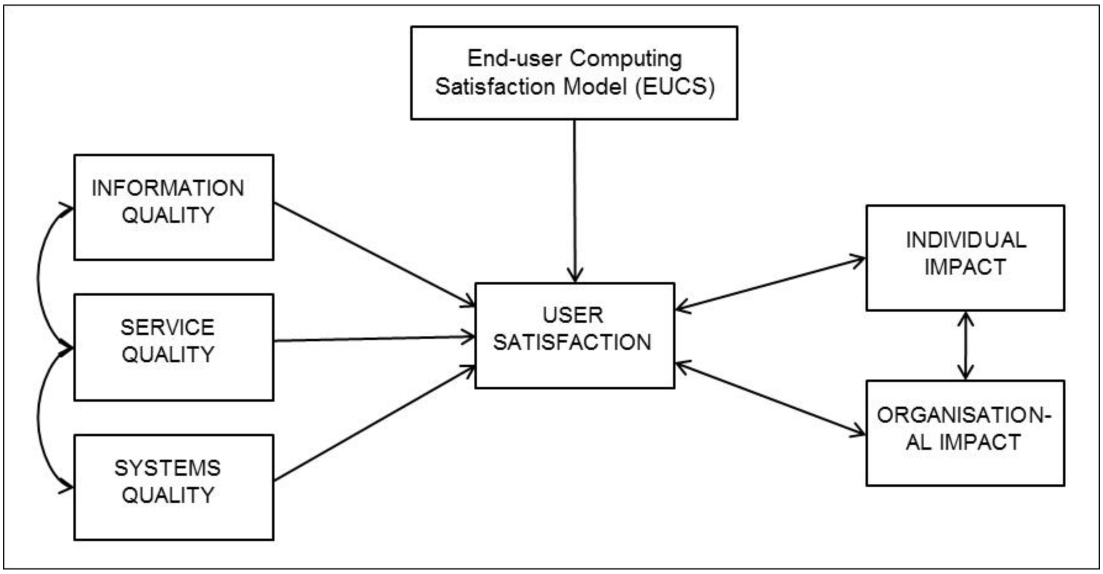


Figure 6.2. Conceptual framework of constructs included in the TVET-MIS-EVAL methodology.

Within the conceptual framework of the MIS success evaluation constructs, relationships with different levels of strength (depending on the MIS under evaluation) exist between the constructs. The relationships are listed in section 6.3.3.2. Apart from measuring each of the constructs separately, it is also important to measure these inter-relationships to identify weaknesses in the system.

6.3.3.2. Relationships between constructs

The arrows in the conceptual framework, depicted in Figure 6.2, suggest the following relationships between the constructs:

- User satisfaction is dependent on information quality, service quality, systems quality, individual impact and organisational impact;
- Information quality is dependent on service quality;
- Systems quality is dependent on service quality;
- Service quality is dependent on information and systems quality;
- Individual impact is dependent on user satisfaction and organisational impact;
- Organisational impact is dependent on user satisfaction and individual impact.

6.3.3.3. Process model for the TVET-MIS-EVAL methodology

The effectiveness measures for measuring the constructs were presented in Chapter 4, section 4.10. These effectiveness measures were sourced from empirically tested survey instruments found in the literature, and incorporated in the toolkit for data collection, as described in the next section. A process model for data collection and data analysis is presented in Figure 6.3.

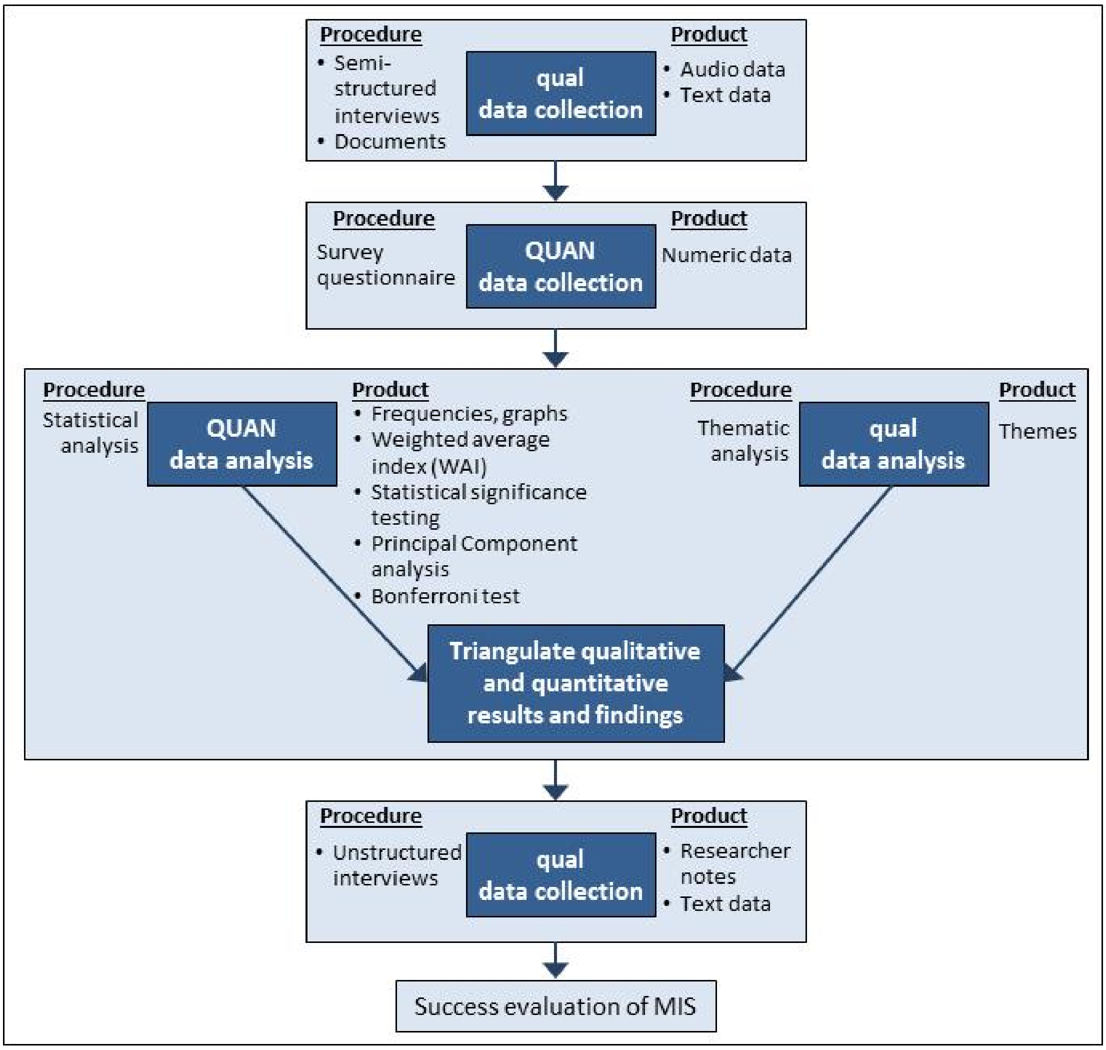


Figure 6.3. Process model for Phase C: Procedures and Phase D: Toolkit within the TVET-MIS-EVAL methodology.

The process model illustrates a process, which should start by conducting semi-structured interviews with the staff responsible for managing the MIS at the public TVET College (cf. Appendix D for the semi-structured interview schedule). Thereafter, a survey questionnaire should be administered to the population of MIS users (cf. Appendix E for the survey questionnaire). These data collection activities should be followed by statistical analysis of quantitative data and thematic analysis of qualitative data. Triangulation of qualitative and quantitative data analysis results should then be performed, where after another round of interviews, with selected survey questionnaire respondents, should be conducted to clarify questions or uncertainties that arouse from the results of the quantitative and qualitative data analysis and from the triangulation of the results. The output from the process model, as illustrated in section 6.3.4, will produce measurement values for each MIS success construct, as well as the strength of inter-associations between constructs.

The following section presents the proposed toolkit for the TVET-MIS-EVAL methodology.

6.3.4. Phase D: Toolkit

The toolkit consists of tools or instruments needed for MIS success evaluation when using the TVET-MIS-EVAL methodology. The toolkit includes suggested data collection instruments, data analysis software, and proposed statistical analysis techniques and procedures.

The survey instrument (presented in Appendix E) is proposed for the collection of mainly quantitative data and the semi-structured interview schedule (available in Appendix D) is suggested for the collection of qualitative data. After the survey questionnaire has been administered and the semi-structured interviews have been conducted, software tools such as Microsoft Access, Microsoft Excel, and the Statistical Package for Social Sciences (SPSS) can be used to capture the quantitative data and the qualitative data can be converted to text by doing transcriptions or by using voice-to-text software tools. Based on the proposed developed instruments, Table 6.2 presents a conceptual framework for the analysis of the qualitative data, Table 6.3 proposes procedures for the analysis of employment and personal information of the respondents and Figure 6.4 presents a conceptual framework for the analysis of the quantitative data related to the evaluation of the constructs in the TVET-MIS-EVAL methodology.

Table 6.2. Conceptual framework for the analysis of qualitative data.

Theme	Questions in interview schedule	Purpose
Theme 1: History and background of the MIS.	Questions 1.1 to 1.7	To understand the historical circumstances of the MIS, for example, how long the system has been in use, how the system developed over time and how it was introduced at the college. Furthermore, to understand the functionality of the system related to day-to-day business activities and how it relates to the college's strategic planning.
Theme 2: Business functions of the MIS.	Question 2.1	To understand the different components and functionalities of the system.
Theme 3: Information Quality.	Question 3.1	To understand the interviewee's perception of the quality of the content captured on the system and the satisfaction with the output reports from the system.
Theme 4: Quality of the system.	Question 4.1	To understand how satisfied the interviewee is with the system, in terms of the ease of use and the graphical user interface design of the system.
Theme 5: Impact of the MIS on individuals.	Question 5.1	To gain insight into the effect of the system on the lives of the individuals using the system.
Theme 6: Impact of the MIS on the organisation.	Question 6.1	To understand the impact of the system on the organisation in terms of improved organisational results and capabilities.
Theme 7: Overall impression of the MIS.	Question 7.1	To understand the overall level of satisfaction with the system, for instance, would the interviewee recommend the system to other colleges, does he/she have suggestions for improvements.
General questions and discussion about the system.	Questions 8 to 10	To understand the relationship between system use and lecturing responsibilities (e-learning), more general information about the suitability of the survey instrument.

In the survey questionnaire, the first part (cf. Appendix E: Employment information, questions 1 to 13) and the last part (cf. Appendix E: Personal information, questions 1 to 6) contain contextual information about the respondent. A conceptual framework for the analysis of this information is offered in Table 6.3.

Table 6.3. Conceptual framework for analysing the *profile* of respondents.

Question number [Variable name]	Type of variable and description	Purpose
Question 1 [q1]: post description.	Text variable. This is an open-ended question and needs to be coded before it can be analysed.	To be able to group respondents according to specific characteristics and to use the variable in cross tabulations with other variables, e.g. association with MIS success.
Question 2 [q2]: position at college.	Nominal variable. Categorise the respondents in three categories: management, lecturing and support staff.	To be able to group respondents according to specific characteristics and to use the variable in cross tabulations with other variables, e.g. association with MIS success.
Question 3 [q3]: part-time or full-time appointment.	Nominal variable. Categorise the respondents according to full-time and part-time appointment.	To be able to group respondents according to specific characteristics and to use the variable in cross tabulations with other variables, e.g. association with MIS success.
Question 4 [q4]: end-user or key-user.	Nominal variable. Categorise the respondents according to end-user or key-user.	To be able to group respondents according to specific characteristics and to use the variable in cross tabulations with other variables, e.g. association with MIS success.
Question 5 [q5]: nature of employment.	Nominal variable. Categorise the respondents according to employment contract – temporary, permanent or casual.	To be able to group respondents according to specific characteristics and to use the variable in cross tabulations with other variables, e.g. association with MIS success.
Question 6 [q6]: years of working experience.	Scale variable. This is a numerical value of the number of years the respondent has been in employment.	Numerical value to assess the total working experience in years of the respondent.
Question 7 [q7]: employment at TVET College.	Scale variable. This is a numerical value of the number of years the respondent has been in employment at the TVET College.	Numerical value to assess the working experience in years of the respondent at the college.
Question 8 [q8]: working experience with MIS.	Scale variable. This is a numerical value of the number of years the respondent has been using the MIS deployed at the TVET College.	Numerical value to assess the total working experience of the respondent.
Question 9 [q9]: training on the use of the MIS.	Nominal variable. Categorise the respondents according to the training received.	To be able to group respondents according to specific characteristics and to use the variable in cross tabulations with other variables, e.g. association with MIS success.
Question 10 [q10]: type of training.	Nominal variable. This question should only be answered if the response to [q9] was “Yes”. Categorise the respondents according to the type of training (in-	To be able to group respondents according to specific characteristics and to use the variable in cross tabulations with other variables, e.g. association with MIS success.

Question number [Variable name]	Type of variable and description	Purpose
	house, external, or both).	
Question 11 [q11] and question 12 [q12]: rates of technical and computer competencies.	Scale variable. [q11] consists of five sub-questions. The respondent has to assess his/her competence in technical, computer and specific software applications on a scale from 1 (poor) to 5 (excellent). [q12] assesses the web/internet proficiency of the respondents.	Numeric variables to assess respondents' proficiency with required skills to be able to perform their duties using the MIS. Procedures to reduce the variables, such as factor analysis or principal component analysis, can be used to assess which of the variables describe the population the best.
Question 13 [q13]: Extent in which the MIS was being used.	Nominal variable. The respondent has to indicate which of the six listed components of the MIS he/she was working on. The responses to the six variables can be summed to create a variable for showing the extent by which the respondent used the MIS.	To be able to group respondents according to specific characteristics and to use the variable in cross tabulations with other variables, e.g. association with MIS success.
Personal information		
Question 1 [p1pop]: population group	Nominal variable. Population group of respondent.	To be able to group respondents according to specific characteristics and to use the variable in cross tabulations with other variables, e.g. association with MIS success.
Question 2 [p2gender]: gender.	Nominal variable. Gender of respondent.	To be able to group respondents according to specific characteristics and to use the variable in cross tabulations with other variables, e.g. association with MIS success.
Question 3 [p3year], [p3month], [p3day]: date of birth.	Scale variable. Date of birth of the respondent. The variable can be divided in three variables to indicate the year, month and day of birth.	To be able to group respondents according to specific characteristics and to use the variable in cross tabulations with other variables, e.g. association with MIS success.
Question 4 [p4disable]: disabilities.	Nominal variable. Respondent has to indicate if he/she is living with any of a list of six disabilities.	To be able to group respondents according to specific characteristics and to use the variable in cross tabulations with other variables, e.g. association with MIS success.
Question 5 [p5hqual]: highest level of qualification of respondent.	Ordinal variable. Respondent has to provide his/her highest level of qualification.	To be able to group respondents according to specific characteristics and to use the variable in cross tabulations with other variables, e.g. association with MIS success.
Question 6 [p6lang]: language respondent most often speaks.	Nominal variable. Respondent has to indicate which of the eleven official languages he/she use most frequently.	To be able to group respondents according to specific characteristics and to use the variable in cross tabulations with other variables, e.g. association with MIS success.

Suggestions for the analysis of contextual factors are presented in Table 6.2, suggestions for the analysis of respondents' characteristics are presented and described in Table 6.3, and now a conceptual framework for the analysis of the factors relating to the evaluation of the different MIS success constructs, as part of the TVET-MIS-EVAL methodology, is presented in Figure 6.4.

Question 14 and its sub-questions in categories A to F in the questionnaire (cf. Appendix E) should be used to calculate the MIS success evaluation constructs. The questions in category F aim to evaluate the overall satisfaction with the system in its entirety. The outcome of category F has to be triangulated with the combined outcome calculated from the measurement of each construct. Triangulation of the results of quantitative and qualitative data analyses should also be done to explain and confirm or reject results.

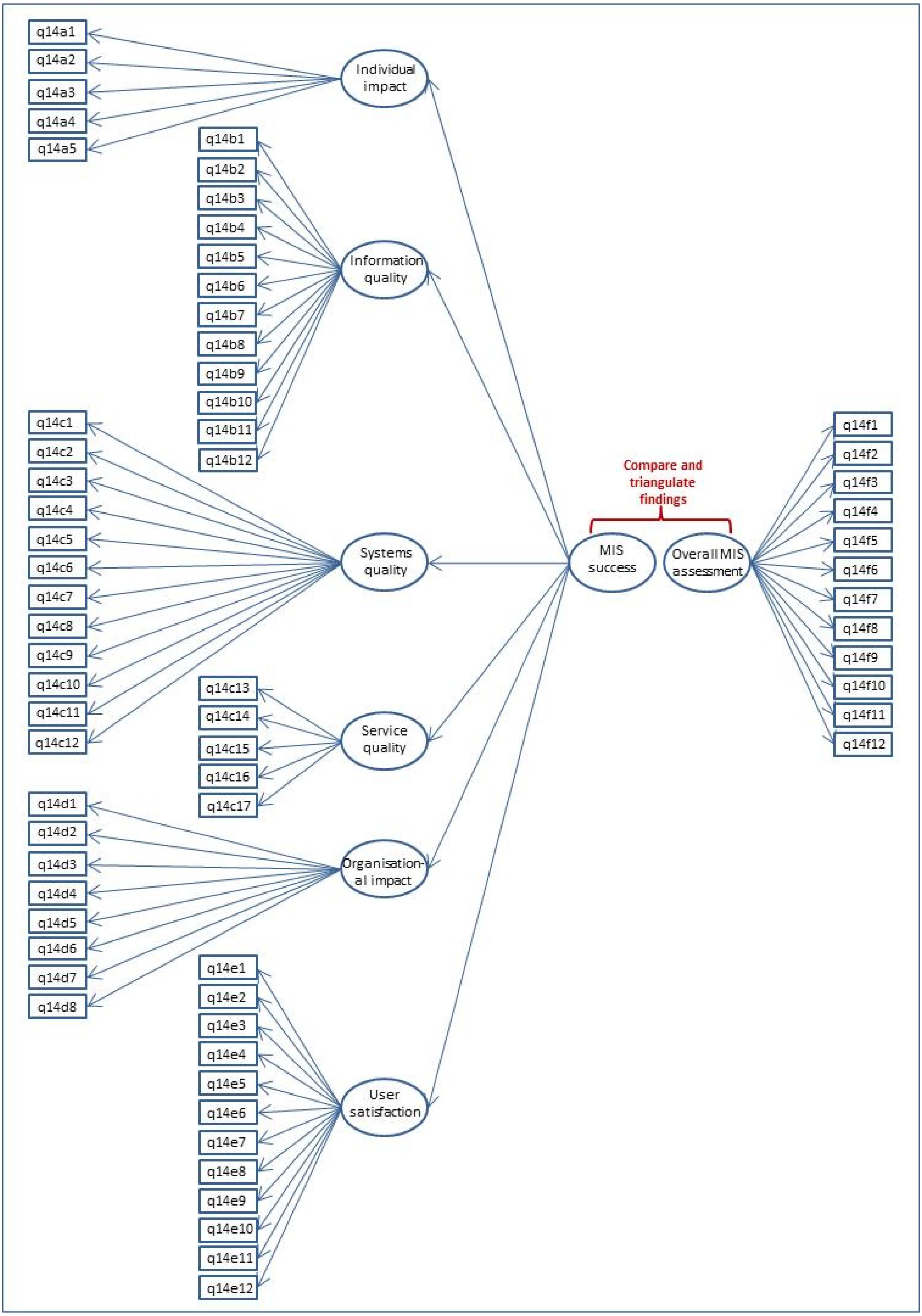


Figure 6.4. Conceptual framework for the analysis of the variables relating to the MIS success evaluation constructs.

After an evaluation score for each construct has been calculated for each respondent, the associations between dependent and independent variables can be explored (cf. section 6.3.3.2). Cross-tabulation between contextual factors and MIS success evaluation constructs can furthermore be investigated.

Table 6.4 provides a list of statistical procedures that can be used in quantitative data analysis.

Table 6.4. Proposed statistical analysis techniques.

Statistical analysis technique	Purpose
Exploratory data analysis (cf. section 2.7.1)	Each variable should undergo exploratory data analysis such as frequency tables and graphs.
Weighted average index (WAI) (cf. section 2.7.2)	WAI should be calculated for variables related to perceptions/opinions of the MIS success evaluation.
Principal component analysis (PCA), rotated factor patterns (cf. section 2.7.3)	PCA should be conducted to evaluate the unidimensionality of the underlying variables of the constructs in the MIS evaluation model.
Cronbach's alpha (reliability of constructs) (cf. section 2.7.4)	This procedure should be performed to establish the internal reliability of the underlying variables of constructs in the MIS evaluation model.
Bivariate correlation – statistically significant correlation (cf. section 2.7.5)	Pearson's correlation coefficient, Kendall's tau_b and Spearman's rho should be calculated to establish the statistical significance of an association between two ordinal or continuous variables.
Shapiro-Wilk test for normality (cf. section 2.7.6)	Tests for normality compare the shape of the sample distribution to the shape of a normal curve. This statistical procedure should be used to test if the dependent variable in the regression analysis satisfies the requirement for normality.
Linear regression analysis (cf. section 2.7.7)	Linear regression analyses should be conducted to calculate the predictor value of each MIS success construct variable for the prediction of the independent variable (*IS success evaluation*).

The last component (Phase E: Standards and Values) of the TVET-MIS-EVAL methodology is presented in the following section.

6.3.5. Phase E: Standards and values

The standards and values of the TVET-MIS-EVAL methodology will depend on the value the college impresses upon it. If evaluation of the MIS is high on the priority list of the public TVET College, more effort will be exerted when applying the artefact and thus better quality results will be produced. Collaboration and participation of college staff, including MIS users, are invaluable for providing insightful and useful qualitative and quantitative results and findings. The value of the artefact will furthermore be affected by the rigour with which qualitative and quantitative data will be analysed.

6.4. Conclusion

The different components, expressed as phases of the TVET-MIS-EVAL methodology, were presented in this chapter. As with any other application, the quality and reliability of the results and findings from applying the TVET-MIS-EVAL methodology will be greatly affected by the dedication of the role players or partners who contribute to the required data inputs and the rigour with which the collected data will be analysed.

If the management of a public TVET College is devoted to obtain tangible evidence through the measurement of the success of the MIS deployed at the college, it is recommended that the application of the TVET-MIS-EVAL methodology be led by institutional strategies. Generally, a strategic plan informs performance plans, budgets, or operational plans and provides the backdrop for institutional monitoring and evaluation and performance assessment. The TVET-MIS-EVAL methodology could strengthen accountability for performance assessment of statistical reporting and functioning of the MIS and could be seen as part of the college-wide performance management system.

The next chapter will explicate and present the innovative cluster-random selection method, which was utilised for the selection of the sample of public TVET Colleges (cases), on which the developed artefact (TVET-MIS-EVAL methodology) was iteratively demonstrated and evaluated.

CHAPTER 7. CLUSTERING OF PUBLIC TECHNICAL AND VOCATIONAL EDUCATION AND TRAINING (TVET) COLLEGES AND SAMPLE SELECTION[3]

7.1. Introduction

“A scientific discipline without a large number of thoroughly executed case studies is a discipline without systematic production of exemplars, and a discipline without exemplars is an ineffective one.” (Flyvbjerg, 2006, p.1)

Case research is a mature methodology in information and knowledge management research, and there is agreement that case selection is critical in ensuring high-quality case research (Benbasat, Goldstein & Mead, 1987). Furthermore, the case selection should be based on characteristics of the context in which the phenomenon being investigated is found, because cases cannot be translated from one context to another, for example, from a developed country context to a developing country context (Mudzana & Maharaj, 2015). What has received less attention is the development of methods for rigorous selection of case studies when there are a large number of cases from which to select (Seawright & Gerring, 2008).

This sub-study contributes to improving information and knowledge management practice, especially if one wants to ensure objectivity in case selection. The purpose of the sub-study is to propose an evidence-based quantitative method for the selection of cases for case study research and to demonstrate this by clustering technical and vocational education and training (TVET) colleges in South Africa into groups with management information systems at similar levels of maturity. The research context is public TVET

[3] The content of this chapter can be regarded as a sub-study within the bigger study. A journal article based on Chapter 7 was published in the South African Journal of Information Management (SAJIM) on 22 March 2017 and can be viewed at http://www.sajim.co.za/index.php /SAJIM/article/view/751. On 26 September 2017, the complete article was viewed 971 times.

Colleges in South Africa. A broad overview of public TVET Colleges in South Africa is provided in Chapter 5.

Samples are data sets, taken from a wider data universe using a particular procedure, in order to generalise about the wider universe with a particular level of confidence (Ben-Zvi, Bakker & Makar, 2015). To make the selection of a representative sample of public TVET Colleges more rigorous, the use of an innovative sampling method was investigated and applied.

It is often not possible or feasible to survey all cases in a context because of cost implications and time constraints. Therefore, sampling is a key factor in making reliable statistical inferences about the universe. It is incumbent on the researcher to clearly define the target population and sample selection approach, but sometimes sampling is an underestimated part of a research study (Field & Hole, 2003; StatPac, 2014). The sample population is defined in keeping with the objectives of the specific study, and although guidelines are available, the researcher has to rely on logic and judgement to make the appropriate sample selection for the study, the latter being a subjective process. The method described here informs an evidence-based approach to case study selection.

Mouton (2001) identifies the use of biased sampling, because of the use of non-probability sampling techniques, as one of the main errors encountered in selecting data sources. Despite the maturity of this issue, the development of statistical reasoning in terms of samples and sampling in the education community deserves further attention (Ben-Zvi *et al*., 2015). Popular techniques for sample selection in qualitative research where case study strategies are implemented are convenient or purposive sampling, which only allows the researcher to generalise the research findings to the specific case under investigation. Serious challenges are likely to develop if a very small sample is randomly selected from a large population of cases without any prior stratification being done (Seawright & Gerring, 2008; Williamson, 2003).

Thus, apart from the four sub-research questions, as presented in section 1.2.3, an additional research question for this sub-study was therefore formulated as follows: *How can an evidence-based quantitative method be used for case selection in information systems research?*

The process that was used to address the problem is based on web maturity models (WMM) theory (Rhoads, 2008). An evaluation questionnaire was developed to investigate the level of maturity of websites of the public TVET Colleges. The colleges were then clustered by using statistical analysis software.

The chapter is presented in four parts. The first part provides the background to the investigation undertaken into the available literature. The methodological approach is then discussed, followed by the presentation of the findings. The chapter concludes by discussing the findings, with specific reference to their implications for improving rigour in case selection.

Since the aim of the thesis is to develop an artefact (methodology) that can be applied to all public TVET Colleges in South Africa, it was crucial to include colleges with different management information systems (MIS) maturity levels in the sample at which the TVET-MIS-EVAL methodology could be evaluated. The problem was *how* to select cases so that colleges with different MIS maturity levels are equally represented.

The content presented in this chapter can thus be situated in Phase 5 of the research process of the study, as described in section 1.3.4, and depicted and shaded in Figure 7.1.

	INPUT →	PROCESS →	OUTPUT
PHASE 1	Literature: Theory, literature, reports, documents, expert discussion and interviews with stakeholders.	Literature review. Introduction to the research problem: *Identify problem and motivation of relevance.*	**Chapter 1:** Introduction to the research study, problem statement and motivation of relevance.
PHASE 2	Information in **Chapter 1.** Literature: theories, models, methods.	Design and develop the research methodology. Literature review: philosophies, paradigms, strategies.	**Chapter 2:** Research design and methodology on how the research problem was addressed.
PHASE 3	**Chapter 1 and 2**. Theory, literature, reports, documents, expert discussion and interviews with stakeholders on: • Methodology development; • IS success evaluation; • MIS at public TVET colleges.	Literature review: the literature studies, document analysis and inferences initialise and address the design science research process (DSRP) model activity: *Define objectives of a solution.*	Production of: • **Chapter 3:** Components of a methodology – output: framework for artefact. • **Chapter 4:** IS success evaluation models – output: model for artefact. • **Chapter 5:** MIS at public TVET colleges: context.
PHASE 4	Information in **Chapters 1-5.**	*Design and development* (Third activity in DSRP) of the initial methodology (artefact) for the evaluation of MIS at public TVET colleges.	**Chapter 6:** Developed TVET-MIS-EVAL methodology including procedures, methods, guidelines, data collection instruments, etc.
PHASE 5	• Theory on Web Maturity Models (WMM) →	• Design questionnaire based on WMM and evaluate public TVET colleges' websites →	• Dataset on website characteristics of public TVET colleges
	• Dataset on characteristics of colleges' websites →	• Cluster analysis →	• Three clusters of public TVET colleges
	• Clusters of colleges →	• Random selection of one college per cluster →	• Sample of three colleges **Chapter 7**
PHASE 6	Developed TVET-MIS-EVAL methodology – **Chapter 6.** Selected cases – **Chapter 7.**	DSRP activities: *Demonstrate, Evaluate, Communicate.* Also referred to as *design-demonstrate-evaluate* and *build-and-evaluate* iterations. Demonstration and evaluation - College 1; Demonstration and evaluation - College 2; Demonstration and evaluation - College 3; Optimized evaluation methodology (artefact)	**Chapter 8:** • Findings from demonstration and evaluation on College 1 • Findings from demonstration and evaluation on College 2 • Findings from demonstration and evaluation on College 3 • Refinements to the TVET-MIS-EVAL methodology (artefact)
PHASE 7	**Chapter 1-8**	Conclude, synthesise, reflect, write and collate (DSRP activity: *Communicate*).	**Chapter 9:** Conclusion

Figure 7.1. Research process of the study delineated by phases, inputs, activities and outputs, underpinned by the design science research process (DSRP) model (Peffers *et al.*, 2006, p. 93).

The following section elucidates key concepts and theoretical frameworks underpinning the sampling method.

7.2. Literature Review

The aim of the literature review is to offer conceptual clarification of the key concepts and theoretical frameworks underpinning the empirical study towards sample selection.

7.2.1. Sample selection and types of sampling

Sampling entails the selection of a subset of cases from the population under investigation. It is not always possible or feasible to conduct a census (which is an official count or survey that collects data from the entire population), because of time and cost constraints. A subset of the population under examination, if representative of the population and if large enough, can provide statistically significant results.

Theory on sampling deals with two domains: probability and non-probability sampling. Probability samples contain some type of randomisation and consist of simple, stratified, systematic, cluster, complex multi-stage or sequential sampling types (Oates, 2006; Summers, 1991). Non-probability samples lack randomisation and consist of the following sample types: convenience or accidental, purposive, quota, accessible, judgement, volunteer or self-selection, snowball and expert. The core distinctions between the two domains are that probability sampling study findings can be generalised to the target population and that it is mainly used in quantitative methods. Non-probability sampling study findings can only be generalised to the institution from which the sample was drawn and it is primarily implemented when using qualitative research methods (Feild *et al*., 2006; Oates, 2006; Summers, 1991). Seddon and Scheepers (2012) emphasise the importance of sample representativeness and the need for researcher judgement when any claim is made about the likely truth of sample-based knowledge claims in other settings.

Seawright and Gerring (2008) emphasise the importance of the selection process when case selection has to be implemented. In most case selection techniques discussed in the literature, in-depth familiarity of each case is needed before a non-probability sample can be drawn.

Case selection in case study research has the same objectives as random sampling which are: (1) to acquire a representative sample and (2) a useful variation on the dimensions of theoretical interest (Seawright & Gerring, 2008). The selection of cases is therefore guided by the position of the case along these two dimensions within the population of interest. Seawright and Gerring (2008) identified the following case selection techniques: typical, diverse, extreme, deviant, influential, most similar and most different cases, and defined these as indicated in Table 7.1.

Table 7.1: Cross-case technique of case selection (Seawright & Gerring, 2008, p. 297).

Technique	Definition
Typical	Cases (one or more) are typical examples of some cross-case relationship.
Diverse	Cases (two or more) exemplify diverse values.
Extreme	Cases (one or more) exemplify extreme or unusual values relative to some univariate distribution.
Deviant	Cases (one or more) deviate from some cross-case relationship.
Influential	Cases (one or more) with influential configurations of the independent variables.
Most similar	Cases (two or more) are similar on specified variables.
Most different	Cases (two or more) are different on specified variables.

Miles, Huberman and Saldana (2014) provide criteria that can be used to evaluate the sample strategy that was used in a research study. The authors suggest that the sample should be relevant to the conceptual frame and research question(s) and that the researcher should make sure that the phenomena under investigation will appear in the sample. The sample plan should be viable in terms of cost, time, access to people and the researcher's own work style. The sampling plan should be ethical in terms of issues such as potential risks and benefits, informed consent and the relationship with informants. The researcher should also evaluate: if the plan will enhance generalisability of findings, either through conceptual power or representativeness; and if the findings will produce believable descriptions and explanations, which would be true in real life.

This brief literature review on sampling provides evidence that sampling is essential to the rigour of any research that relies on statistical inference, and also in research where the selection of the case study needs to be justified as non-convenient as often applies to research in information management and educational contexts. Sample selection is critical in ensuring research rigour yet non-trivial and that provides the rationale for this sub-study into innovate, evidence-based sampling methods.

The following section provides information about Web Maturity Models theory which was used in the development of the website evaluation questionnaire for the sub-study.

7.2.2. Web Maturity Models Theory

The literature revealed that information and communication technology (ICT) is an essential enabler for economic and social development in an organisation and that it enhances the competitiveness of organisations (UNCTAD & TNSO, 2008). ICT, which includes websites and management information systems (MISs), improves communication, operational efficiencies, sales turnover and information quality in organisations (Burgess, Sellitto & Karanasios, 2009). Hence, the maturity and sophistication level of an organisation's website is indicative of the level of sophistication of its ICT, including its MISs.

Maturity models reveal the degree of technological sophistication and organisational transformation (Ziemba & Papaj, 2013). Organisations also recognise the strategic importance of knowledge management and sharing, and the practise of using platforms such as the World Wide Web for this purpose (Mannie, Van Niekerk & Adendorff, 2013).

The term *maturity* relates to the degree of formality and optimisation of processes. The concept of maturity is fundamental to the evaluation of systems, and maturity models are used in different fields, such as business, education and information systems, to evaluate and monitor progress. The capability maturity model (CMM) identifies different levels of maturity in organisations; for most of the CMMs, the maturity scale structure includes five levels (Esterhuizen, Schutte & du Toit, 2012; Paulk *et al*., 1993; Rhoads, 2008). CMMs exist for many applications used in organisations, such as software development; information technology development; management; and project, data, business and knowledge management (Esterhuizen *et al*., 2012). The WMM builds on the CMM and can also be used to assess the maturity of an organisation's website (Rhoads, 2008).

The European Union eGovernment WMM represents the degree of technological sophistication and organisational transformation in government agencies (Ziemba & Papaj, 2013). Fath-Allah, Cheikhi, Al-Qutaish and Idri (2014) compared 25 eGovernment maturity models and identified *presence*, *interaction*, *transaction* and *integration* as the criteria that differentiated the first four maturity levels in most of those websites. The levels of service and complexity are similar to those described for the European Union eGovernment model, but the latter proposes five levels because it distinguishes between one-way interaction and two-way interaction (Ziemba & Papaj, 2013). The general website maturity model of the University of British Columbia (UBC) (UBC, 2015) identifies *initial*, *repeatable*, *defined*, *managed* and *continual* process improvement as the five stages, and it becomes clear that the stages depend on the context and the purpose of the website.

The design of an evaluation questionnaire for the evaluation of public TVET Colleges' websites was modelled on Paulk *et al*. (1993) and Rhoads (2008) who focused on process control. The levels are as follows:

- level 1 relates to ad hoc business practices with no control at all;
- level 2 relates to stable processes with a repeatable level of statistical control;
- level 3 relates to defined processes to ensure consistent implementation;
- level 4 relates to managed result metrics; and
- level 5 relates to active optimisation of the processes.

The WMM suggests that a website develops in maturity from level 1 to level 5, as depicted in Figure 7.2. Websites at level 1 provide basic introductory information about the institution (*presence*). The website evolves to level 2, if it includes text or information about the organisation, graphics, contact details and a feedback mechanism (*interaction*); websites progress to level 3 (*transactional*) if there is a search engine and more detailed information on what is offered by the institution (e.g. courses, training programmes and catalogues); websites advance to level 4 (*integration*) if they have systems such as content and distribution management, and evidence customer relationship management strategies and credit card processing functionality. A website maturity level 5 offers portal capability and personalised capability and contains multimedia content such as videos and multiple language choices.

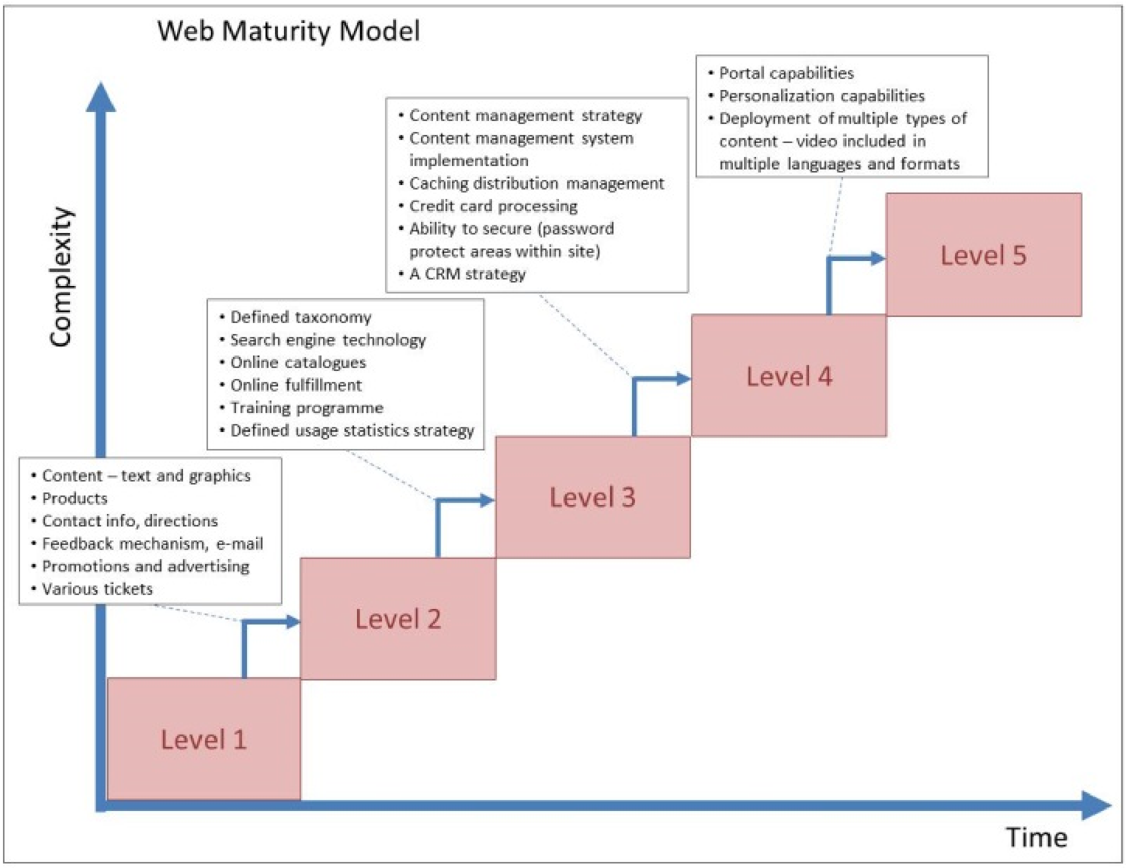


Figure 7.2. Web maturity model (Rhoads, 2008).

In addition to evidence of specific components (*functionality*) on the website, as suggested by the WMM, Remenyi (2002) provides 10 main evaluation criteria for website maturity; each of these includes a number of sub-criteria. The main evaluation criteria include the following (Remenyi, 2002): first impressions, navigation, content, attractors, findability, making contact, browser compatibility, knowledge of users, user satisfaction and other useful information. Most of these criteria relate to *user experience*.

The concepts *website maturity*, *user-centred design* and *usability* are intricately related (Earthy, Jones & Bevan, 2001). Tullis and Albert (2013) view *usability* as the ability of the user to use the product to successfully perform a task; this is measured in terms of *effectiveness*, *efficiency* and *user satisfaction* in completing a task. *User experience* takes a broader view of the entire interaction with the product and includes *thoughts*, *feelings* and *perceptions* (Tullis & Albert, 2013). This aligns with the view of Rubinoff (2004), who describes user experience as consisting of four factors, namely *usability*, *content*, *branding* and *functionality*. A discussion of *user experience* and *usability* is beyond the scope of this sub-study, but it suffices to say that the sub-study aligns with the view of *user experience* subsuming *usability*, with the focus here being on *usability*, *content* and *functionality*, for purposes of identifying the maturity attributes. Furthermore, *content* is measured in terms of its authority, purpose, usefulness, coverage, currency, objectivity and accuracy (Dalhousie University, 2015).

7.2.3. Inter-rater reliability

The reliability of a measure is defined as the ability to produce the same results under the same conditions (Field & Hole, 2003). Whenever humans are involved in conducting an evaluation, concerns are raised about the reliability and consistency of the results. Inconsistency in ratings is possible because the evaluators or raters could have been distracted, they become tired of doing repetitive tasks or they could have misinterpreted the evaluation criteria. However, there are ways in which consistency among raters can be determined.

Four general classes of reliability estimates are identified (Trochim, 2006). The inter-rater or inter-observer reliability procedure is used to measure the degree to which the same phenomenon receives a consistent score by different raters. In statistics, inter-rater reliability, inter-rater agreement and concordance are described as the extent of agreement among raters. It shows how much homogeneity, or consensus, there is in the ratings. The second class of reliability estimates includes test-retest reliability, which is a procedure used to assess the consistency of a measure from one time to another. A single rater can, for instance, rate a phenomenon twice at different times. The third class includes parallel-forms reliability. This procedure is used to measure consistency in the results of two tests constructed in the same way using the same content domain. The fourth class consists of internal consistency reliability procedures, which assess the consistency of results across items within a test.

The most commonly known procedures that can be used for inter-rater reliability tests are the joint probability of agreement test (Uebersax, 1987); Cohen's (1960) Kappa statistics, which works for two raters; and Fleiss' Kappa (Fleiss, 1971), which is an improvement on Cohen's Kappa (1960) and which works on any fixed number of raters. Correlation coefficients such as Spearman's ρ (rho) and Pearson's r can also be used to consider pairwise correlation among raters when using a scale that is ordered. Another method by which reliability testing can be performed is intraclass correlation coefficients (ICC); this is done by calculating the proportion of variance of an observation because of between subject variability in the true scores (Field, 2006; Landis & Koch, 1977; Ludbrook, 2010).

Field (2009) notes two common uses of ICC: firstly, comparing paired data on the same measure; and secondly, assessing the consistency between the ratings provided by raters for a set of objects.

Calculation of the ICC depends on whether a measure of consistency (in which the order of scores from a source is considered but not the actual value around which the scores are anchored) or absolute agreement (in which both the order of scores and the relative values are considered), and whether the scores represent averages of many measures or just a single measure, is required (Field, 2009).

7.2.4. Cluster Analysis

Cluster analysis is a group of multivariate statistical techniques used to group data from a population into groups with similar characteristics. Three types of clustering techniques exist: hierarchical, non-hierarchical and a combination of hierarchical and non-hierarchical clustering techniques (Caccam & Refran, 2012).

In hierarchical clustering analysis, the algorithm initially creates a cluster for each record or case in the database and then groups the cases together on the basis of similarities. It is a stepwise procedure that results in the construction of a hierarchy or treelike structure of clusters (Sadiq, 2012; Sarstedt & Mooi, 2014). In non-hierarchical clustering analysis, a pre-determined number of categories are created, based on a selected criterion; the cases are then sorted into the categories or clusters based on similarities, using an iterative algorithm that optimises the chosen criterion (Sadiq, 2012; Sarstedt & Mooi, 2014).

The third technique, in which both hierarchical and non-hierarchical cluster methods are used, is called TwoStep cluster analysis (Elliott & Woodward, 2007; Sadiq, 2012). This method uses a hierarchical approach first and then a non-hierarchical approach. The hierarchical procedure produces the clusters; the non-hierarchical method then uses the produced clusters and clusters each case again to provide a more accurate cluster membership.

7.3. Research Design

7.3.1. Data Source and Sample

An evaluation questionnaire was developed based on WMM theory, which included *user experience* attributes (cf. section 7.2.2 and Appendix H). The aim of the questionnaire was to gather data on the website characteristics of the total population of 50 public TVET Colleges in South Africa. A Microsoft Access form was created to capture the collected data. A pilot of the instrument was done by three evaluators after which questions 4 and 5 were refined. The main data collection was conducted by nine evaluators, who scored the different aspects of the college websites and captured their scores on the Microsoft Access form. The Statistical Package for the Social Sciences (IBM SPSS version 24) programme was utilised to calculate the inferential statistics. Inter-rater reliability was established and the collected data on website characteristics were subjected to cluster analysis techniques, in order to present clusters of public TVET Colleges with similar website characteristics. TVET Colleges' website maturity was used as a proxy for TVET Colleges' MIS(s) maturity.

The questionnaire consisted of 17 questions (cf. Appendix H). Fifteen of the seventeen questions queried the websites in terms of the availability of specific components, such as establishment date, contact and direction details, having a feedback mechanism, having search engine technology and having social media links. These components are related to the different maturity levels of websites. The other two questions, together with their sub-questions (question 4 and sub-questions 4a to 4g; question 5 and sub-questions 5a to 5e), required the evaluators to provide a score from 1 (poor) to 5 (excellent) for the appearance, usability and content information presented on the websites.

A sample of nine evaluators from three institutions was selected to conduct the survey – seven female and two male evaluators. One of the evaluators was part of the research team, and the other eight were master's interns (5) and university students (3), who were chosen conveniently. One of the evaluators was a researcher, another was an expert in web design, five were studying in the domain of computer-user interaction and the other two had studied mechanical engineering. The evaluators were trained on how to rate each aspect of the website to ensure that they used the same evaluation criteria. The total population of public TVET College websites was evaluated.

Because the method used to cluster the public TVET Colleges relied heavily on the scores given by the evaluators, it was important to check the scores for consistency and reliability. ICC were calculated to determine inter-rater reliability (cf. section 7.2.3) to establish absolute agreement in the average scores of the nine evaluators on questions 4 and 5.

After inter-rater reliability had been established, TwoStep cluster analysis (cf. section 7.2.4) was used to group the colleges, based on website maturity level. The level of maturity of a college's website was used as a proxy for the maturity level of the college's MIS(s).

Data management and analysis for this sub-study were conducted by using IBM SPSS version 24, Microsoft Excel 2010 and Microsoft Access 2010.

The results and findings are presented in the following section.

7.4. Results and Findings

7.4.1. About the websites

An analysis of the year of establishment of the websites revealed that most of the websites were established recently. Seventeen (34%) of the websites were less than 2 years old; 10 (20%) were 2 to 3 years old; 4 (8%) were 4 to 5 years old and 4 (8%) were older than 5 years. Two (4%) TVET Colleges did not own a website, and the dates of establishment were not displayed on 13 (26%) of the websites (Figure 7.3).

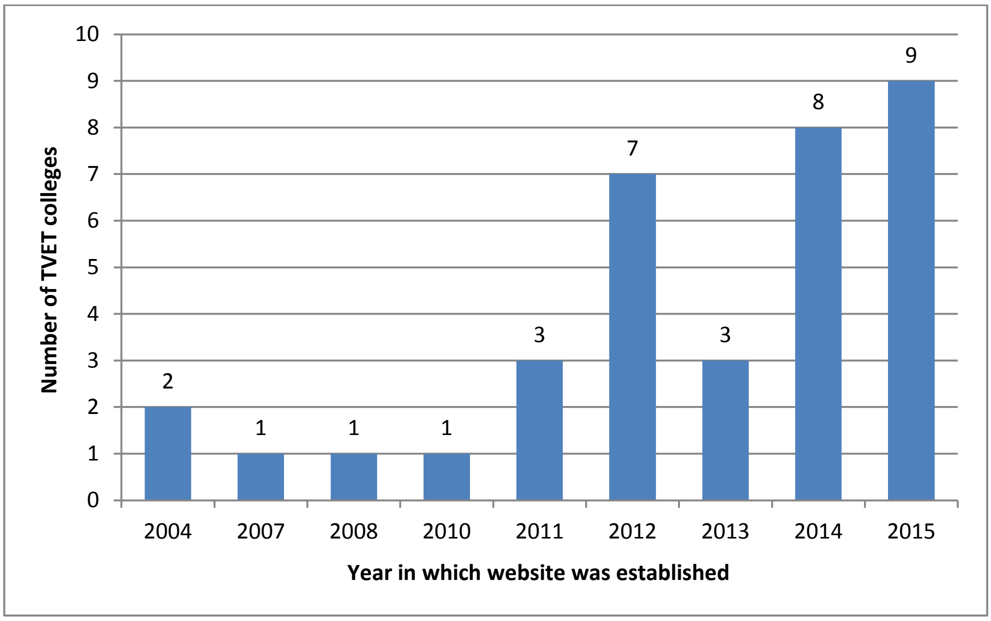


Figure 7.3. Year of establishment of TVET Colleges' websites.

Table 7.2 presents the number of websites that contained the listed components. Evidently, most of the 48 college websites contained components associated with the second level of web maturity, such as contact details (98%), directions (96%) and a feedback mechanism (74%). The fact that 77% of the websites had social media links could indicate a high usage of this functionality by stakeholders (students, staff, suppliers, etc.). Just more than half (53%) of the websites made provision for students to download a registration form. The reason for this phenomenon could be related to the illegal practice of downloading and selling registration forms to potential students who are without Internet access (as explained on one of the college websites).

In the light of the current focus on e-learning, the utilisation of social media platforms for improving academic performance of TVET students in the country and the fact that one of the biggest challenges identified by public TVET College lecturers was the lack of adequate contact hours for teaching (Dzvapatsva *et al*., 2014), it is surprising that only one in five websites (10 websites or 21%) had a portal capability for students. More than a third (17 or 36%) of the websites had electronic links to career portals.

Table 7.2. Number of websites by availability of specific components.

Components on website	Websites with capability		Web Maturity Level
	Number	Percentage	
Contact details	46	98%	2
Directions to college	45	96%	2
Feedback mechanism	35	74%	2
Search engine technology	27	57%	3
Social media links	36	77%	3
Registration form can be downloaded	25	53%	3
Register online	6	12%	4
Payment online	1	2%	4
Portal capabilities for students	10	21%	5
Deploy multiple types of content	7	15%	5
Linked to career portal or partners	17	36%	5
Login facilities for staff or suppliers	16	33%	5

The evaluators had to provide a score ranging from 1 (poor) to 5 (excellent) to questions and sub-questions 4 and 5 in the survey instrument. These questions examined the 'look-and-feel and usability' and 'content and information' of the websites, respectively (cf. Appendix H). A weighted average index (WAI) was calculated for the scores provided by the evaluators at questions 4 and 5, as presented in Table 7.3. The WAIs of all evaluators were above the average of 2.5, which indicated that, on average, most of the websites were user-friendly and contained useful information. The minimum and maximum WAI values were (3.2 and 4.1) and (2.8 and 4.0), respectively, for the 'look-and-feel and usability' and value of 'content and information'. This indicates that more attention should be given to the 'content and information' on the websites.

Table 7.3. Frequencies of websites' scores by evaluators.

Category	Evaluator value	Poor				Excellent	Total	WAI
	Score	1	2	3	4	5		
Look-and-feel and usability	Evaluator 1	0	4	6	20	17	47	4.1
	Evaluator 2	2	8	21	11	5	47	3.2
	Evaluator 3	0	6	27	10	4	47	3.3
	Evaluator 4	0	9	23	9	6	47	3.3
	Evaluator 5	3	4	15	21	0	43	3.3
	Evaluator 6	1	3	28	11	2	45	3.2
	Evaluator 7	1	1	11	22	10	45	3.9
	Evaluator 8	1	1	12	19	12	45	3.9
	Evaluator 9	5	7	12	13	7	44	3.2
Content and information	Evaluator 1	0	1	13	16	17	47	4.0
	Evaluator 2	0	5	20	13	9	47	3.6
	Evaluator 3	0	11	19	15	2	47	3.2
	Evaluator 4	2	5	19	19	2	47	3.3
	Evaluator 5	6	4	24	10	0	44	2.9
	Evaluator 6	2	2	27	16	0	47	3.2
	Evaluator 7	1	2	8	19	15	45	4.0
	Evaluator 8	2	3	14	19	7	45	3.6
	Evaluator 9	9	10	8	15	2	44	2.8

WAI=Weighted Average Index (Mean score)

7.4.2. Inter-rater reliability findings

An inter-rater reliability analysis was performed, using the ICC to determine absolute agreement among the average scores of the evaluators at questions 4 and 5 separately. The averages for questions 4a to 4g (variables were named $evalq4^i$ where $i \in \{1,2,3, ... 9\}$) and questions 5a to 5e (variables were named $evalq5^i$ where $i \in \{1,2,3, ... 9\}$) were calculated for each TVET College per evaluator. These average scores were used in the calculation of the ICC to establish inter-rater reliability.

The ICC were calculated by using a two-way random model, which controlled for evaluator effects and measured absolute agreement in which both the order of scores of evaluators and the relative values were considered. An ICC value of 0.7 and above is generally interpreted as acceptable, 0.8 and above is considered optimal and 0.9 and above is considered excellent (Field 2006, 2009).

Table 7.4 depicts the results of the ICC for the 'look-and-feel and usability' evaluation of the websites (from evalq4[i]); Table 7.5 depicts the results for the 'content and information' evaluation (from evalq5[i]). The tables include two sets of results: one for single measures and the other for average measures. We are interested in the average measures, which show how consistent the ratings were among all evaluators.

The inter-rater reliability on the scores for 'look-and-feel and usability' (Table 7.4) was found to be ICC (2,9) = 0.806 ($p < 0.000$), 95% CI (0.697, 0.885). In other words, the ICC value was 0.806, which indicates optimal agreement in the evaluators' scores. The confidence interval (CI) indicates that 95% of the samples of the data can be expected to have an ICC value between 0.697 and 0.885. The data thus seem to be reliable, with little variability between the evaluators. In addition, 80.6% of the variance in the means of the evaluators' scores was real and not because of chance.

Table 7.4. Intraclass Correlation Coefficient on the raters' scores on the websites' look-and-feel and usability.

	Intraclass Correlation[b]	95% Confidence Interval		F Test with True Value 0			
		Lower Bound	Upper Bound	Value	df1	df2	Sig
Single Measures	.316[a]	.204	.460	6.410	40	320	.000
Average Measures	.806	.697	.885	6.410	40	320	.000

Two-way random effects model where both people effects and measures effects are random.
a. The estimator is the same, whether the interaction effect is present or not.
b. Type A intraclass correlation coefficients using an absolute agreement definition.

The inter-rater reliability for evaluator scores on the 'content and information' (Table 7.5) was found to be ICC (2,9) = 0.721 ($p < 0.000$), 95% CI (0.564, 0.835). In other words, the ICC value was 0.721, which indicates an acceptable agreement in the evaluators' scores. The CI indicates that 95% of the samples of the data can be expected to have an ICC value between 0.564 and 0.835. The data thus seem to be reliable, with little variability between the evaluators. In addition, 72.1% of the variance in the means of the evaluators' scores was real and not because of chance.

Table 7.5. Intraclass Correlation Coefficient on the raters' scores on the websites' content and information.

	Intraclass Correlation[b]	95% Confidence Interval		F Test with True Value 0			
		Lower Bound	Upper Bound	Value	df1	df2	Sig
Single Measures	.223[a]	.126	.359	4.908	40	320	.000
Average Measures	.721	.564	.835	4.908	40	320	.000

Two-way random effects model where both people effects and measures effects are random.
a. The estimator is the same, whether the interaction effect is present or not.
b. Type A intraclass correlation coefficients using an absolute agreement definition.

After the Inter-rater reliability had been established and the data was found to be reliable, cluster analysis was performed on the data.

7.4.3. Cluster analysis findings

A TwoStep cluster analysis, which includes both hierarchical and non-hierarchical cluster methods, was performed on the data to find a suitable model to cluster the colleges. The TwoStep cluster analysis made use of the log-likelihood distance measurement and was based on Schwarz's Bayesian criterion.

Three input variables were used in the cluster analysis, that is, the overall average of all evaluators' scores for question four (variable named Avgq4) and for question five (variable named Avgq5), and a newly created variable called Compfinal. The variable Compfinal represented the number of components included on the websites of the colleges; this was generated by calculating the sum of the values for questions 6 and 8 to 17 in the questionnaire for each college. The values for the variable Compfinal could, therefore, be any number from 0 to 11 (dichotomous variables: 0 = no or 1 = yes). Descriptive statistics for the variable Compfinal were calculated: values ranged from 0 to 7, the mean was M = 4.08 and the standard deviation was SD = 1.75.

Figure 7.4 presents the results of the most suitable model of clusters. The model presents a silhouette measure of cohesion and separation of above 0.5, which indicates cluster quality and a good model fit. Usually, an acceptable ratio of cluster sizes is between 2 and 3 (Sadiq 2012; Sarstedt & Mooi 2014), but because two TVET Colleges did not own a website, a separate cluster to contain those colleges and the colleges with websites at a low maturity level made sense, and the cluster ratio size of 10.00 was accepted.

The model presented three clusters: cluster 1 (6% or 3 colleges) represents colleges with no websites or websites at a very low maturity level; cluster 2 (60% or 30 colleges) represents colleges with websites at an average maturity level; cluster 3 (34% or 17 colleges) represents colleges with good quality websites. The technical report in which the outcome of the cluster analysis is presented can be viewed at Appendix F.

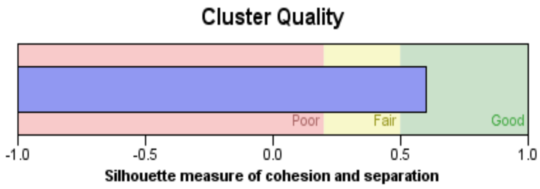
The results can be summarised as follows:

- Websites in cluster 1 had, on average, one of the 11 components; were evaluated at 0.55, on average, for 'look-and-feel and usability', were rated, on average, at 0.46 for 'content and information' quality.
- Websites in cluster 2 had, on average, three of the 11 components; and scored, on average, 3.29 and 3.06 for 'look-and-feel and usability' and 'information and content', respectively.
- Websites in cluster 3 had, on average, six of the 11 components; and scored, on average, 4.02 and 3.67 for 'look-and-feel and usability' and 'information and content', respectively.

The results are graphically presented in Figure 7.4, in which it is evident that the input variable Avgq5 had the highest predictor importance (1.00) and the other two variables – 'mean score of evaluators on question 4' (Avgq4) and Compfinal – contributed 0.99 and 0.96 to the prediction of the clusters, respectively.

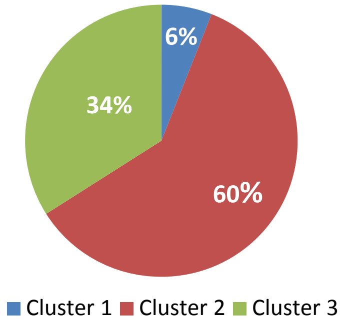
(a) Model summary

Algorithm	TwoStep
Inputs	3
Clusters	3

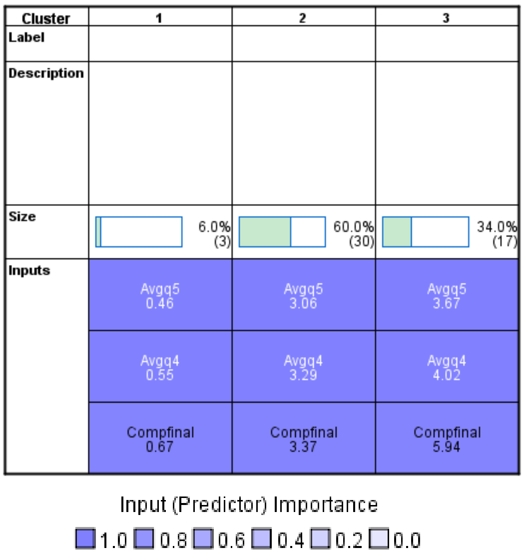


(b) Cluster sizes

Size of smallest cluster	3 (6%)
Size of largest cluster	30 (60%)
Ratio of sizes: largest cluster to smallest cluster	10.00



(c) Clusters



(d) Predictor importance

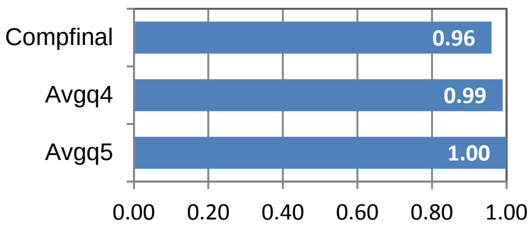


Figure 7.4. Model summary (a), cluster sizes (b and c) and predictor importance (d) as calculated with TwoStep cluster analysis.

One public TVET College was randomly selected from each cluster as representative of the cluster and used as a case for the demonstration and evaluation of the TVET-MIS-EVAL methodology. To protect the anonymity of the colleges the selected colleges were named College 1 from Cluster 1, College 2 from Cluster 2 and College 3 form Cluster 3.

7.5. Discussion

This sub-study has implications for methods of selecting cases for qualitative case study research. The sub-study showed how the set of 50 public TVET

Colleges was grouped into groups with similar website characteristics. An evaluation questionnaire was developed, based on WMM theory. The evaluation questionnaire included user experience attributes and was used by nine evaluators to evaluate the websites of the 50 public TVET Colleges in South Africa. Inter-rater reliability of the nine evaluators was established, with the calculation of ICC. Hierarchical and non-hierarchal cluster analysis (TwoStep) was used to cluster the population of public TVET Colleges.

Three groups emerged from the analysis (cf. Figure 7.5): colleges without a website or websites at a low maturity level (cluster 1); colleges with websites that achieved an average score for first impression of structure, appearance, navigation, ease of finding specific functionality and the comprehensiveness and usefulness of content and information about programmes offered and how to apply and register at the college (cluster 2); and colleges that met the usability requirements of user experience and satisfaction, information requirements and comprehensive functionality in terms of number of components available (cluster 3).

It is important to keep in mind that the outcome of statistical or technical procedures should (as far as possible) be verified with qualitative empirical evidence (Punj & Stewart, 1983). Although we have to reject clusters that do not meet minimum statistical requirements, this does not mean that clusters that are statistically acceptable are the only meaningful clustering outcome (Klastorin, 1983). Future studies could investigate other methods to cluster public TVET Colleges into groups with similar website or MIS characteristics.

Furthermore, for future research that focuses on websites or MISs at public TVET Colleges, researchers could select cases from the three clusters to ensure representation of all categories. One should also take into consideration that college websites and MISs develop and grow in maturity over time, and therefore, it might be necessary to repeat this analysis in future to enable up-to-dating of the categorisation of public TVET Colleges in groups with similar website or MIS characteristics.

7.6. Conclusion

The aim of the sub-study was to propose an evidence-based quantitative method for the selection of cases for case study research. The method was demonstrated by clustering TVET Colleges in South Africa based on website maturity models, as a proxy for information systems maturity.

The method of case selection presented in this sub-study is a more rigorous alternative to convenient or purposive sample selection techniques and was intended to be uncomplicated and replicable by researchers and practitioners with different levels of proficiency in statistical analysis.

Technological developments have provided many tools for new and innovative ways of analysing data. However, to ensure rigour in the selection of cases in qualitative research studies, it is important that researchers also develop innovative methods for sample selection to overcome subjectivity and bias. The evidence-based method, which used quantitative data, is a contribution in terms of basic practice for sample selection. Quantitative data were gathered through an evaluation questionnaire to generate a proxy for the level of IS development of individual public TVET Colleges in South Africa. The presented method can be applied by any researcher to ensure that objectivity is ensured when selecting cases and to ensure rigour in the research methodology of a study.

Besides the practical contribution of clustering public TVET Colleges, the value of this sub-study resides on the evidence-based method, and the replicative value that it offers researchers and practitioners in any field of study, where cases for in-depth case studies, has to be selected. A summary of the method is provided in Appendix G. The novelty lies in using a specific characteristic as proxy for clustering the cases, so that at least one case from each cluster can be selected. Clustering of the population in this sub-study was based on the maturity level of the population’s websites, but in other populations, other easily accessible and available relevant information could be collected, captured and used in cluster analysis. Future research is needed to triangulate the findings from the quantitative clustering with a qualitative method, for example, clustering by expert review.

The following chapter presents the findings derived from the application of the TVET-MIS-EVAL methodology to the three selected cases towards suggestions for refinements of the artefact.

CHAPTER 8. ARTEFACT DEMONSTRATION AND EVALUATION THROUGH CASE STUDIES TOWARDS REFINEMENT OF THE TVET-MIS-EVAL METHODOLOGY

8.1. Introduction

The TVET-MIS-EVAL methodology was designed, developed and constructed in chapter 6. Literature reviews, as presented in: chapter 3 about methods, methodologies and paradigms; chapter 4 regarding models for the evaluation of MIS success; and in chapter 5 which described the context at which the newly created artefact should be applied, was used as building blocks to develop the artefact.

When using design science (DS) research to build artefacts, it is essential to evaluate the newly created artefact (Hevner *et al.*, 2004), and therefore a sample of cases (public TVET Colleges) was selected for the demonstration and evaluation of the applicability of the TVET-MIS-EVAL methodology (cf. chapter 7). The final sub-research question of the study, namely, *How do the results of the evaluation of the MISs at public TVET Colleges compare and contribute to the evaluation of the developed methodology?* (cf. section 1.2.3.5), was addressed during the design science research process (DSRP) activities of demonstration and evaluation. Findings from these activities were reported in this chapter.

A sample of three colleges was selected by using an innovative, evidence-based sample selection technique, described in Chapter 7. A journal article based on the content of Chapter 7 was published in 2017 (Visser, van Biljon & Herselman, 2017). Cluster analysis techniques applied on the population of public TVET Colleges produced three clusters based on the maturity level of the college websites, which was used as a proxy for the maturity level of the MIS implemented at the colleges (cf. Chapter 7 and Visser *et al*. [2017]). One case was randomly selected from each of the three clusters. Colleges in Cluster 1 displayed the lowest MIS maturity level whilst colleges in Cluster 3 exhibited the highest MIS maturity level compared to the population of colleges. The newly created artefact was iteratively applied to the three selected public TVET Colleges (College 1 from Cluster 1, College 2 from Cluster 2 and College 3 from Cluster 3) and after each application the research findings were noted and used to inform improvements to the artefact. It is important to note that testing of the artefact on colleges with different MIS maturity levels contributed to enhanced rigour and applicability of the artefact – i.e. to its generalisability.

The activities in this chapter correspond to the fourth and fifth design science research process (DSRP) model activities which are the demonstration and evaluation of the created artefact, respectively. This chapter furthermore presents Phase 6 of the research process of the study as depicted and shaded in Figure 8.1.

	INPUT →	PROCESS →	OUTPUT
PHASE 1	Literature: Theory, literature, reports, documents, expert discussion and interviews with stakeholders.	Literature review. Introduction to the research problem: *Identify problem and motivation of relevance.*	**Chapter 1:** Introduction to the research study, problem statement and motivation of relevance.
PHASE 2	Information in **Chapter 1.** Literature: theories, models, methods.	Design and develop the research methodology. Literature review: philosophies, paradigms, strategies.	**Chapter 2:** Research design and methodology on how the research problem was addressed.
PHASE 3	**Chapter 1 and 2**. Theory, literature, reports, documents, expert discussion and interviews with stakeholders on: • Methodology development; • IS success evaluation; • MIS at public TVET colleges.	Literature review: the literature studies, document analysis and inferences initialise and address the design science research process (DSRP) model activity: *Define objectives of a solution.*	Production of: • **Chapter 3:** Components of a methodology – output: framework for artefact. • **Chapter 4:** IS success evaluation models – output: model for artefact. • **Chapter 5:** MIS at public TVET colleges: context.
PHASE 4	Information in **Chapters 1-5.**	*Design and development* (Third activity in DSRP) of the initial methodology (artefact) for the evaluation of MIS at public TVET colleges.	**Chapter 6:** Developed TVET-MIS-EVAL methodology including procedures, methods, guidelines, data collection instruments, etc.
PHASE 5	• Theory on Web Maturity Models (WMM) • Dataset on characteristics of colleges' websites • Clusters of colleges	• Design questionnaire based on WMM and evaluate public TVET colleges' websites • Cluster analysis • Random selection of one college per cluster	• Dataset on website characteristics of public TVET colleges • Three clusters of public TVET colleges • Sample of three colleges **Chapter 7**
PHASE 6	Developed TVET-MIS-EVAL methodology – **Chapter 6.** Selected cases – **Chapter 7.**	DSRP activities: *Demonstrate, Evaluate, Communicate.* Also referred to as *design-demonstrate-evaluate* and *build-and-evaluate* iterations Demonstration and evaluation - College 1 Demonstration and evaluation - College 2 Demonstration and evaluation - College 3 Optimized evaluation methodology (artefact)	**Chapter 8:** • Findings from demonstration and evaluation on College 1 • Findings from demonstration and evaluation on College 2 • Findings from demonstration and evaluation on College 3 • Refinements to the TVET-MIS-EVAL methodology (artefact)
PHASE 7	**Chapter 1-8**	Conclude, synthesise, reflect, write and collate (DSRP activity: *Communicate*).	**Chapter 9:** Conclusion

Figure 8.1. Research process of the study delineated by phases, inputs, activities and outputs, underpinned by the design science research process (DSRP) model (Peffers *et al.*, 2006, p. 93).

The following sections provide findings derived from the application of the developed artefact (TVET-MIS-EVAL methodology) on the MIS deployed at each selected college, which in turn contributed towards the refinement of the artefact. Section 8.2 provides a brief description of how the TVET-MIS-EVAL methodology was used to evaluate the MIS at the selected cases. A synthesis of the characteristics of the three cases is provided in section 8.3. Each of the sections, sections 8.4, 8.5 and 8.6, provides results and findings derived from the application of the TVET-MIS-EVAL methodology on the three selected colleges: College 1, College 2 and College 3, respectively.

The following section describes *how* the artefact (as presented in Chapter 6) was applied to the selected sample of colleges. The description is structured according to the phases or components of the TVET-MIS-EVAL methodology (artefact), which consists of a philosophical dimension (philosophical paradigm) and a technical dimension (Phase A: Principles; Phase B: Guidelines, practices and rules; Phase C: Procedures; Phase D: Toolkit; and Phase E: Standards and values).

8.2. Application of the artefact (TVET-MIS-EVAL methodology)

The TVET-MIS-EVAL methodology is underpinned by pragmatism. The focus in a pragmatic philosophical paradigm is on practical application - theories or beliefs are evaluated with the view of how successful they are in practice (Goldkuhl, 2012). Philosophical assumptions and views of interpretivists and post-positivists were incorporated during the application of Phase C: Procedures and Phase D: Toolkit of the TVET-MIS-EVAL methodology.

The main principle of the TVET-MIS-EVAL methodology is to evaluate the MIS at the selected public TVET Colleges (Phase A). The application of the TVET-MIS-EVAL methodology was guided by the guidelines, practices and rules (Phase B) as presented in section 6.3.2 and extended in Table 8.1. The third column in Table 8.1 describes how the guidelines, practices and rules were utilised during the demonstration and evaluation of the artefact as it was applied on the selected colleges.

Table 8.1. Application of the TVET-MIS-EVAL methodology guidelines (Phase B) (cf. section 6.3.2).

Guideline	Description	How the guideline was utilised:
Guideline 1: Involve stakeholders	Stakeholders (e.g. college management and staff) should be involved in the process of MIS evaluation by informing them about objectives, outcomes, outputs, activities and other elements to ensure buy-in and ownership of endeavours to improve the MIS quality and functionality at the institution.	Access to the colleges was initiated through the CEO/Principal of the college and management thus approved of the study. IT and MIS managers at each of the three colleges were interviewed to elicit information about the college and the MIS, but also to explain the objectives of the study and to gain their support in administering the survey questionnaire.
Guideline 2: Assess contextual data	Apart from a sole focus on the MIS under evaluation, the context and actors (contextual data) should also be assessed because this will also influence the achievement of results. The MIS of each institution should be understood on its own terms. Institutions have different levels of organisational, managerial and information communication technology maturity and contextual factors should be reported on and also taken into account in the evaluation process.	Literature reviews on the selected colleges were performed, prior to visiting the college, to understand the context and location of the selected colleges and the community they serve. Semi-structured and unstructured interviews with college management also provided contextual information to gain a deeper understanding of the colleges and the MISs deployed at the colleges. The evaluation of the college websites to determine the maturity level of the MIS deployed at the college was very useful in the interpretation of the results.
Guideline 3: Flexible application	Use the TVET-MIS-EVAL methodology and its components as a flexible application rather than a fixed map of evaluation. For instance, alternative data analysis methods could be used to analyse the data, as long as it utilises rigorous methods.	During the application of the artefact the developed instruments, as described in section 6.3.3 (Phase C: Procedures) and section 6.3.4 (Phase D: Toolkit), which are components of the artefact, were used. Flexibility in the data analysis techniques was possible.

Guideline	Description	How the guideline was utilised:
Guideline 4: Support to IT/ICT unit	The TVET-MIS-EVAL methodology provides an outline for evaluating MIS at public TVET Colleges. The TVET-MIS-EVAL methodology thus enables the IT/ICT unit to achieve the following: • Translate its mandate into tangible results; • Support ongoing planning, management and monitoring functions; • Lay out objectives and priorities; • Support the measuring of MIS success; • Help demonstrate contributions to higher-level goals (e.g. data quality for reporting on targets set at national level by the DHET); and • Measure results on component level within the MIS utilised.	The application of the artefact produced tangible results for MIS success evaluation that can be used by the IT/ICT unit for planning, management and monitoring purposes. The results produced from the success evaluation of the MIS were disaggregated to the construct level including the measurement of the constructs: information quality, systems quality, service quality, user satisfaction, individual impact and organisational impact. This quality of the artefact enables the identification of aspects of the MIS that need support or an intervention for improvement.
Guideline 5: Verifiable contribution	The effective application of the TVET-MIS-EVAL methodology must provide clear and verifiable contributions in the evaluation, outputs and outcomes of the evaluation.	The application of the artefact provided clear and verifiable measurement values that can be replicated at different periods and stages in the life of the MIS.
Guideline 6: Research rigour	The TVET-MIS-EVAL methodology relies upon the application of rigorous methods in both the collection and analysis of data.	Rigorous data collection and data analysis methods were utilised during the application of the artefact, as evident in sections 8.4, 8.5 and 8.6. Validity was achieved because the instruments did, in fact, measure what they were supposed to measure, namely the MIS success constructs.
Guideline 7: Communication	The results and findings of the success evaluation by using the TVET-MIS-EVAL methodology must be presented effectively, both to technology-oriented as well as	All results and findings derived from the application of the artefact were recorded in the thesis and supporting MS Excel and IBM SPSS files. After completion of the study, copies of the thesis will

Guideline	Description	How the guideline was utilised:
	management-oriented audiences.	be distributed to the participating colleges and also presented in academic journals and at conferences. A journal article based on Chapter 7 was published in the South African Journal of Information Management (SAJIM) on 22 March 2017 and can be viewed at http://www.sajim.co.za/ index.php/SAJIM/article/view/751. On 26 September 2017, the complete article was viewed 971 times.

The conceptual models for MIS success evaluation, as presented in section 6.3.3, and which is part of the component *Phase C: Procedures* of the artefact, were used as quantitative and qualitative approaches for the success evaluation of the MIS. *Phase D: Toolkit*, which comprises of the instruments developed in this study and which is presented in section 6.3.4, was utilised for the collection of quantitative and qualitative data for the evaluation of the MIS at the selected cases (cf. Appendices C, D and E). Demonstration of the application of the artefact on the three selected cases and presentation of the results derived from the application of the artefact are presented in sections 8.4, 8.5 and 8.6.

As discussed in section 4.9, when a MIS is evaluated (entailing the evaluation of six MIS success constructs) it is essential to also consider contextual information including organisational, individual and task characteristics (Petter, DeLone & McLean, 2013). The following section provides contextual information of the three selected cases.

8.3. Characteristics of the selected colleges

As an introduction, and to inform the contexts of the selected cases, the location, size and other relevant information of each college was collected and presented in Table 8.2. Evidently, the selected colleges are distinctly different. College 1 is located in a semi-rural area with a smaller population than the headcount enrolment of the college, which is indicative of the fact that it serves not only its immediate area but also neighbouring areas and communities. The large difference between the headcount and full-time equivalent enrolment numbers in College 1 shows that the majority of students enrolled for less than the requisite number of courses per qualification per year and therefore students will take longer to complete a qualification.

Table 8.2. Characteristics of selected colleges.

Characteristics	**College 1**	**College 2**	**College 3**
Cluster [1]	Cluster 1	Cluster 2	Cluster 3
MIS maturity [1]	Below average	Average	Above average
Geographical area [2]	108.90 km^2	36.21 km^2	183.50 km^2
Population in area [2]	26 338	43 966	121 610
Population density [2]	240/km^2	1,200/km^2	660/km^2
Industry [2]	Agriculture	Commercial and agriculture	Mining, manufacturing and engineering industries, agriculture
Urban/Rural classification [2]	Town	Large town	City
Management staff [3]	10	9	4
Lecturing staff [3]	135	286	293
Support staff [3]	136	230	195
Headcount students [3]	33 787	11 024	17 855
Full-time equivalent (FTE) students [3]	4 905	4 520	12 157
FTE/Lecturing staff ratio [4]	36	16	41
Number of MIS users [5]	15	16	47
Number of campuses [6]	3	4	5

Sources:

1. *Derived from the innovative evidence-based clustering of public TVET Colleges.*
2. *Sourced from Wikipedia the Free Encyclopaedia.*
3. *(DHET, 2017)*
4. *Author's own calculation.*
5. *Derived from application of the TVET-MIS-EVAL methodology.*
6. *Sourced from http://www.tvetcolleges.co.za/Site_Public_FET.aspx*

It is furthermore evident from Table 8.2, that MIS maturity levels increase along with an increased level of industry development and the level of urbanisation of the area in which the college is located. During semi-structured interviews complaints about internet connectivity influencing the efficiency of the MIS were communicated (Interviewee 1, 2015; Interviewee 4, 2015). Internet connectivity and access to strong signals decrease with increased distances from communication towers. Another observation is that the number of staff who utilised the MIS on a daily basis at the college, increased with an increase in the MIS maturity level. This is indicative of an increased decentralised approach in the management and operation of the MIS as the MIS maturity increases (Interviewee 2, 2015).

The following sections present the results derived from applying *Phase C: Procedures* and *Phase D: Toolkit* of the TVET-MIS-EVAL methodology to the selected colleges. Results from data analysis of qualitative data collected via semi-structured interviews with college CEOs, IT and MIS managers and of quantitative data from a survey questionnaire administered to all users of the system deployed at the colleges, are presented. In all three cases the criteria used for establishing eligibility of staff to participate in the survey, was persons who used the deployed management information system on a daily basis as part of their work responsibilities.

For each case results of data analyses are presented in the following topic order:

- High level summary of qualitative data and information;
- Demographics of MIS users;
- Calculation of computer proficiencies of users by using Principal Component Analysis (PCA);
- Extent of use of the MIS;
- Evaluation of MIS;
    - Confidence intervals (CI) and Weighted Average Index (WAI) of each MIS success evaluation item;

- Reduction of items underlying the main MIS success constructs by using PCA;
- Descriptive statistics of MIS success evaluation constructs;
- Correlation matrix of MIS success evaluation constructs; and
- Investigation of relationships between MIS constructs by using regression analysis.

8.4. College 1: Findings transpired from the application of Phase C: Procedures and Phase D: Toolkit of the TVET-MIS-EVAL methodology

Fifteen staff members utilised the MIS on a daily basis and were responsible for capturing and maintaining the data and information on the system related to student administration, academic administration, financial administration, human resource management and development, asset management, and technical administration and maintenance of the system. Eight of the fifteen staff members responded to the survey questionnaire (cf. Appendix E), thus a response rate of 53% was achieved. No demographic information about the non-respondents was available and therefore weights were not applied to the realised sample. One semi-structured interview was conducted with the MIS Officer of College 1.

8.4.1. Qualitative data and information

Qualitative data and information were collected via a semi-structured interview with the MIS Officer (Interviewee 5, 2015). On the day of the scheduled interview, students at the college were demonstrating in support of the #FeesMustFall campaign and no entry to the college was possible. After traveling a long way to meet with the MIS Officer, and since all attempts to make contact with the MIS Officer had failed, the researcher decided to have breakfast at a local coffee shop and to her surprise discovered that the interviewee was also there. The interview thus took place at the coffee shop. The discussion mainly followed the topics as listed in the semi-structured interview schedule (cf. Appendix D).

In 2015, College 1 migrated to another MIS system (the name of the system is withheld because of confidentiality reasons) and at the time of the field visit (cf. Section 2.5.6.3) MIS users had been using the new system for more or less than one year, depending on when the staff member started using the system (Interviewee 5, 2015).

High level findings from the interview are presented here. It became evident from the discussion that the college had had an unfortunate experience with the previous MIS service provider and had been forced to invest in another MIS and service provider. The transition and migration to the new system held many challenges and the process was implemented on a modular basis because of financial constraints. At the time of the interview only three modules: the student administration, examination administration and human resource management and development modules, had been acquired from, and implemented by, the service provider. Challenges with module and campus integration caused some delays in the implementation of the system. According to the interviewee the system was complicated and not user-friendly and therefore the staff needed intensive training to understand the system, and the meaning of the many menus, codes and commands. They also had challenges logging into the system.

The interviewee admitted that the system had contributed to improved information quality since many validation rules assist in accurate data capturing. Many student records had been duplicated in the previous system and this had posed major challenges, but this issue had been resolved with the new system. The interviewee believed that, apart from the costly investment, the system was beneficial to the organisation, especially as it enabled the college to provide the DHET with more accurate data, in line with the DHET requirements. A close monitoring of strategic targets as set by the DHET was furthermore also possible. Another high level finding was that Wi-Fi internet connectivity, especially for the purpose of communicating between campuses and the main office, caused challenges from time-to-time. Additional qualitative findings will be integrated where applicable in the quantitative findings presented in the following sections.

The following section presents information on the demographic profile of the MIS users at College 1.

8.4.2. Demographics of MIS users

Data analysis of the survey administered to users of the MIS at College 1 revealed the following results:

- Half of the respondents were males and all respondents were younger than 35 years of age;
- The highest level of education of 43% of the respondents was equal to an advanced diploma, a bachelor's, honours, master's or doctoral degree. The rest of the respondents had a diploma or advanced certificate, which is expected because the focus of TVET Colleges is on vocational education and training;
- 25% of the respondents were lecturing and 75% were support staff;
- 75% were full-time and 25% part-time employees;
- Most of the respondents were end-users (75%) – the rest key-users;
- 75% were permanent and 25% fixed-term employees;
- 50% of respondents had less than five years of working experience in total and 62.5% had less than five years working experience at the college; and
- 85.7% of the respondents received training on the MIS, of which the majority, 83.3%, received training from the external service provider.

8.4.3. Computer proficiency of users

A series of questions (question 11a to 11e) in the survey questionnaire investigated the level of computer proficiency of MIS users. A Principal Component Analysis (PCA) of these items produced three components, as depicted in Tables 8.3 and 8.4. The three components explained 99.3% of the total variance in the sample (Table 8.3).

A variable for computer proficiency was generated by using the responses to the following questions: firstly, the averages of the extracted components were calculated (i.e. average for questions 11c and 11b called *CompSkills*; average for questions 11a and 11d called *TechSkills*); and secondly, the average of the *CompSkills, TechSkills,* and question 11e was calculated. The final variable was called *CompProf* (computer proficiency). All respondents scored above average levels for computer proficiency, whilst half of the respondents rated themselves as having excellent computer proficiency skills.

Table 8.3. Principal Component Analysis (PCA): Total variance explained.

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumula-tive %
1	2.248	44.958	44.958	2.248	44.958	44.958	2.073	41.454	41.454
2	1.628	32.561	77.519	1.628	32.561	77.519	1.743	34.865	76.318
3	1.090	21.793	99.312	1.090	21.793	99.312	1.150	22.994	99.312
4	0.034	0.688	100.000						
5	0.000	0.000	100.000						

Extraction Method: Principal Component Analysis.

Table 8.4. Principal Component Analysis: Extracted components.

Items	Component		
	1	2	3
q11c_word Competency in MS Word?	0.995		
q11b_comp Competency in computer skills?	0.995		
q11a_tech Competency in technical skills?		0.965	
q11d_excel Competency in MS Excel?		0.897	
q11e_email Competency in email software?			0.989

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalisation.
a. Rotation converged in 4 iterations.

The following section presents information about the extent of user involvement in the MIS.

8.4.4. Extent of use of the MIS

The staff responsible for maintaining and operating the MIS at the time of the survey consisted of two lecturing staff and six support staff. The manager of the MIS was called the MIS Officer and was categorised as part of the support staff (Table 8.5).

Four users used one module of the system during their daily activities. This might be as a result of the system being in operation for only more or less a year (depending on the user – some users had used the system for only six months). Modules were added over time in a sequential manner, on the basis of financial viability of the college. Technical support and maintenance of the system was managed by the service provider (Interviewee 5, 2015). At the time of the survey only three components were implemented, which included the student administration, academic (examination) administration and the human resource management and development module.

Table 8.5. Position of staff by number of components used daily, College 1.

Position of staff	One component	Two components	Three components	Total
Lecturing staff	2	0	0	2
Support staff	2	2	2	6
Total	4	2	2	8

The manager of the MIS was involved in all three components, the two lecturing staff members were both involved in only one component, namely the academic administration module. Most of the users were responsible for student and academic administration activities (Figure 8.2).

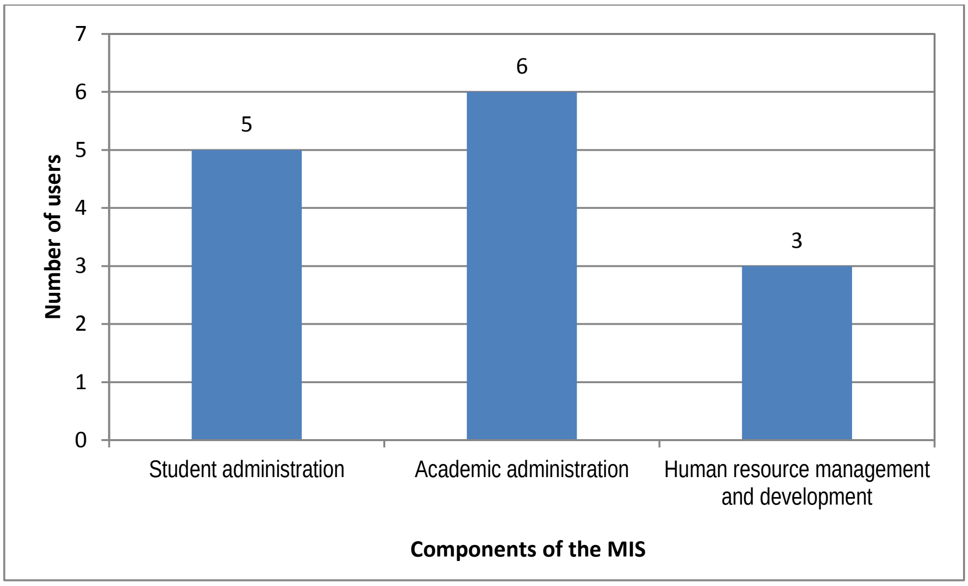


Figure 8.2. Number of users by MIS component used, College 1.

Sections 8.4.1, 8.4.2 and 8.4.3 reported on the profile of the MIS users for the purpose of understanding the user context of the setting in which the MIS is utilised. The following section will focus on the evaluation of the MIS itself.

8.4.5. Evaluation of MIS

One of the instruments, the survey questionnaire, which was developed as part of Phase D: Toolkit of the TVET-MIS-EVAL methodology was used to evaluate the MIS deployed at the college (cf. Appendix E). Question 14 of the questionnaire included six categories of sub-questions used to measure the MIS evaluation constructs. The development of the questionnaire, including these items, was presented in Chapter 4, section 4.10. The categories comprise of the following:

- Category A: INDIVIDUAL-IMPACT is concerned with how the MIS has influenced the individual capabilities and effectiveness of the user, on behalf of the organisation. Five items (q14a1 to q14a5) were used to measure this construct.
- Category B: INFORMATION-QUALITY is concerned with the quality of the MIS outputs: namely, the quality of the information the system produces in reports and on-screen. Twelve items (q14b1 to q14b12) were used to measure this construct.
- Category C: SYSTEM-QUALITY of the MIS is a multifaceted construct designed to capture how the system performs from a technical and design perspective. Twelve items (q14c1 to q14c12) were used to measure this construct.
- Category C: SERVICE-QUALITY is concerned with the quality of the MIS service provider. Five items (q14c13 to q14c17) were used to measure this construct.
- Category D: ORGANISATIONAL-IMPACT refers to impacts of the MIS at the organisational level; namely improved organisational results and capabilities. Eight items (q14d1 to q14d8) were used to measure this construct.

- Category E: USER SATISFACTION - About the satisfaction of the user with the MIS. Twelve items (q14e1 to q14e12) were used to measure this construct.
- Category F: Overall evaluation of the MIS. Twelve items (q14f1 to q14f7, q14f8a, q14f8b, and q14f9 to q14f11) were used to measure the overall success of the MIS. The calculated value (from the twelve items) for each participant was compared to the combination of the values calculated for each participant in the MIS success evaluation constructs in the bullet points above.

A Likert-rating scale of one to five was implemented for each item – the value: *one* represented *'Never or almost never'* and the value: *five* represented *'Always or almost always'*. The code, 6=*'Not applicable/I don't know*', in the data was recoded to reflect a missing value and the recorded rates or scores for all negatively stated items were recoded to reflect a positive statement, for instance, question q14b1 (*Information available from the MIS is not important*) was recoded to reflect a positive statement (*Information available from the MIS is important*).

The measurement of the different constructs and the inter-relationships among them for College 1 is presented in the following sections. The next section considers the rated scores by individual item (question in the questionnaire).

8.4.5.1. Statistical significance and Weighted Average Index (WAI)

The confidence interval for each item in the questionnaire related to the success evaluation constructs (i.e. Information quality, Systems quality, Service quality, User Satisfaction, Individual impact and Organisational impact) of the MIS was calculated and showed that all variables were statistically significant at the 95% confidence level, with t-values above 1.96 and p-values below 0.05, as presented in Table 8.6.

Weighted average indices and means were calculated for each item and are presented in Table 8.6. The means varied from a maximum of 4.83 for *How* *often does the information content meet your needs?* to a minimum of 2.40 for *The output reports from the system are consistent and accurate*.

Users of the system evidently valued the content and output reports of the MIS highly, because the item: '*How often does the information content meet your needs?',* had the highest mean score of 4.83; the item: '*Information from the MIS is in a format that is readily usable'*, had the second highest mean of 4.71; the item: '*Information from the MIS is always timely'*, had the third highest mean of 4.71. These indicate that most of the users perceived that their information needs were met; the information was timely; and was in a format readily usable, most of the time. These characteristics relate to output quality which is very important for monitoring and evaluation, as well as strategic planning. This finding confirmed that the system is designed to adhere to the Department of Higher Education's prescribed format for submission requirement (Interviewee 5, 2015).

It is important to note that users reported that the *MIS helped to improve communication and relationships* most of the time, which was rated a score of on average 4.57 (eleventh highest). Of the 54 items two items, the seventh and eleventh highest rated (with means of 4.60 and 4.50 respectively), related to the internal and external service providers. The MIS users were of the opinion that the service providers were experienced and provided quality services, most of the time. The twenty-eighth highest rated item (4.17) related to the usability of the MIS: *The MIS is easy to learn*. The users reported that they found it easy to learn how to use the MIS system, most of the time. This could have been as a result of the quality training which they had reportedly received (average score of 4.00).

The item that received the lowest mean of 2.40 related to inconsistencies in the content of the output reports from the system. The system had been implemented and used for just more than a year and these inconsistencies might be related to growing pains, but they could also indicate that more care should be taken with data capturing responsibilities. Three of the lowest rated eight items related to costs: *The MIS is cost effective* (3.71); *The MIS has* *resulted in cost reductions* (3.71); *The MIS has resulted in reduced staff costs* (3.00). These indicate that the users perceived the MIS as costly and they possibly did not perceive the system to be value for money.

Figure 8.3 illustrates the overall frequencies of the different scores. It is evident that almost half (46%) of the items were scored the value five, which indicates that MIS users perceived the system to perform well almost all of the time.

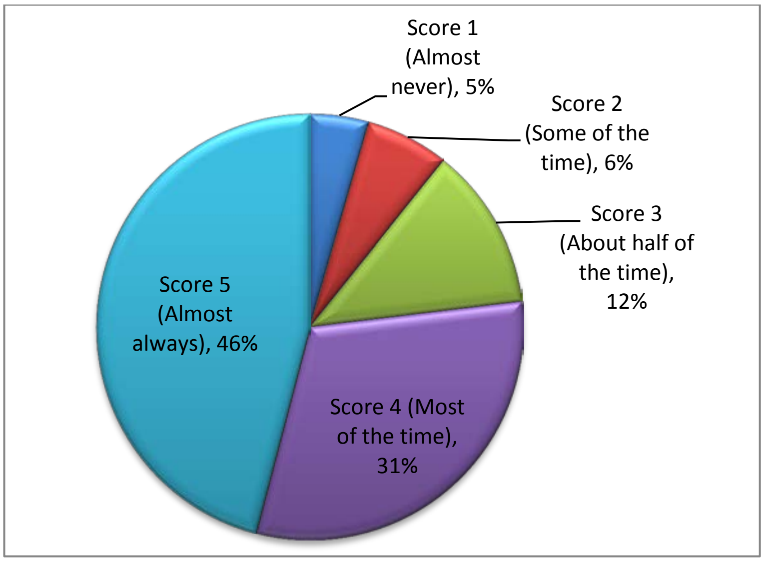


Figure 8.3. Distribution of participants' scores across all MIS evaluation items, College 1.

Table 8.6. Statistics with regard to the items/variables used in the success evaluation of the MIS at College 1.

MIS success evaluation constructs and underlying items (variables)	Mean	Std. Deviation	Std. Error Mean	t (Test Value = 0)	df	Sig. (2-tailed)	95% Confidence Interval of the Mean			Frequency of score					
							Lower	Upper	N	1	2	3	4	5	WAI
Individual impact															
q14a1_rc I have learnt much through the presence of the MIS	4.00	1.069	0.378	10.583	7	0.000	3.11	4.89	8		1	1	3	3	4.00
q14a2_rc The MIS enhances my awareness of job related information	4.13	0.835	0.295	13.981	7	0.000	3.43	4.82	8			2	3	3	4.13
q14a3_rc The MIS enhances my recall of job related information	4.25	0.886	0.313	13.561	7	0.000	3.51	4.99	8			2	2	4	4.25
q14a4_rc The MIS enhances my effectiveness in the job	4.13	0.835	0.295	13.981	7	0.000	3.43	4.82	8			2	3	3	4.13
q14a5_rc The MIS increases my productivity	4.25	0.886	0.313	13.561	7	0.000	3.51	4.99	8			2	2	4	4.25
Information quality															
q14b1_rcrev Rev: Information available from the MIS is not important	4.43	0.787	0.297	14.892	6	0.000	3.70	5.16	7			1	2	4	4.43
q14b2_rc The MIS contains all the key data that is needed	4.43	0.787	0.297	14.892	6	0.000	3.70	5.16	7			1	2	4	4.43
q14b3_rc Information available from the MIS is always accurate (does not often need correction)	4.00	0.816	0.309	12.961	6	0.000	3.24	4.76	7			2	3	2	4.00
q14b4_rcrev Rev: Information from the MIS is never updated and current	4.14	1.464	0.553	7.488	6	0.000	2.79	5.50	7	1			2	4	4.14
q14b5_rc The MIS provides output that seems to be exactly what is needed	4.43	0.787	0.297	14.892	6	0.000	3.70	5.16	7			1	2	4	4.43
q14b6_rc Information needed from the MIS is always available	4.43	0.787	0.297	14.892	6	0.000	3.70	5.16	7			1	2	4	4.43
q14b7_rc Information from the MIS is in a format that is readily usable	4.71	0.488	0.184	25.562	6	0.000	4.26	5.17	7				2	5	4.71
q14b8_rcrev Rev: Information from the MIS is not easy to understand	3.88	1.458	0.515	7.519	7	0.000	2.66	5.09	8	1		2	1	4	3.88
q14b9_rc Information from the MIS appears readable, clear and well formatted	4.43	0.787	0.297	14.892	6	0.000	3.70	5.16	7			1	2	4	4.43
q14b10_rc Information from the MIS is concise	4.29	1.113	0.421	10.190	6	0.000	3.26	5.31	7		1		2	4	4.29
q14b11_rc Information from the MIS is always timely	4.71	0.488	0.184	25.562	6	0.000	4.26	5.17	7				2	5	4.71
q14b12_rc Information from the MIS is unavailable elsewhere	2.83	2.041	0.833	3.400	5	0.019	0.69	4.98	6	3			1	2	2.83
System quality															
q14c1_rcrev Rev: The MIS is not easy to use	3.86	1.464	0.553	6.971	6	0.000	2.50	5.21	7	1		1	2	3	3.86
q14c2_rc The MIS is easy to learn	4.17	0.983	0.401	10.381	5	0.000	3.13	5.20	6			2	1	3	4.17
q14c3_rc It is not difficult to get access to information that is in the MIS	3.33	1.506	0.615	5.423	5	0.003	1.75	4.91	6	1	1		3	1	3.33
q14c4_rc All data within the MIS is fully integrated and consistent	4.67	0.516	0.211	22.136	5	0.000	4.12	5.21	6				2	4	4.67
q14c5_rc The MIS meets (the TVET College's) information requirements	4.60	0.548	0.245	18.779	4	0.000	3.92	5.28	5				2	3	4.60

MIS success evaluation constructs and underlying items (variables)	Mean	Std. Deviation	Std. Error Mean	t (Test Value = 0)	df	Sig. (2-tailed)	95% Confidence Interval of the Mean			Frequency of score					
							Lower	Upper	N	1	2	3	4	5	WAI
q14c6_rcrev Rev: The MIS does not include necessary features and functions	3.67	1.751	0.715	5.129	5	0.004	1.83	5.50	6	1	1		1	3	3.67
q14c7_rc The MIS always does what it should	4.67	0.516	0.211	22.136	5	0.000	4.12	5.21	6				2	4	4.67
q14c8_rc The MIS user interface (screen) can be easily adapted to one's personal approach (customise)	4.00	1.414	0.632	6.325	4	0.003	2.24	5.76	5		1	1		3	4.00
q14c9_rc The MIS is always up-and-running as necessary (It has good connectivity, e.g. to network, server access, etc.)	4.20	1.304	0.583	7.203	4	0.002	2.58	5.82	5		1		1	3	4.20
q14c10_rc The MIS programme speed is quick enough (responds quickly)	3.80	1.304	0.583	6.517	4	0.003	2.18	5.42	5		1	1	1	2	3.80
q14c11_rc The MIS requires only the minimum number of fields and screens to achieve a task	3.80	1.304	0.583	6.517	4	0.003	2.18	5.42	5		1	1	1	2	3.80
q14c12_rc Modifications to the functionality of the MIS can easily be done (modified, corrected and improved)	4.00	1.225	0.548	7.303	4	0.002	2.48	5.52	5		1		2	2	4.00
Service quality															
q14c13_rc The MIS's service provider is reliable	3.83	1.329	0.543	7.064	5	0.001	2.44	5.23	6		1	2		3	3.83
q14c14_rc The MIS's service provider has up-to-date facilities	3.50	1.378	0.563	6.220	5	0.002	2.05	4.95	6		2	1	1	2	3.50
q14c15_rc The MIS's service provider is experienced	4.50	0.548	0.224	20.125	5	0.000	3.93	5.07	6				3	3	4.50
q14c16_rc The MIS's service provider provides quality training	4.00	1.265	0.516	7.746	5	0.001	2.67	5.33	6		1	1	1	3	4.00
q14c17_rc The MIS's service provider provides quality services	4.60	0.548	0.245	18.779	4	0.000	3.92	5.28	5				2	3	4.60
Organisational impact															
q14d1_rc The MIS has resulted in overall productivity improvement	4.25	0.886	0.313	13.561	7	0.000	3.51	4.99	8			2	2	4	4.25
q14d2_rc The MIS has resulted in improved outcomes or outputs	4.43	0.787	0.297	14.892	6	0.000	3.70	5.16	7			1	2	4	4.43
q14d3_rc The MIS has resulted in an increased capacity to manage a growing volume of activity (e.g. transactions, population growth etc.)	4.00	0.926	0.327	12.220	7	0.000	3.23	4.77	8			3	2	3	4.00
q14d4_rc The MIS has resulted in improved business processes	3.86	0.900	0.340	11.342	6	0.000	3.03	4.69	7			3	2	2	3.86
q14d5_rc The MIS has helped to improve communication and relationships	4.57	0.535	0.202	22.627	6	0.000	4.08	5.07	7				3	4	4.57
q14d6_rc The MIS is cost effective	3.71	1.380	0.522	7.120	6	0.000	2.44	4.99	7		2	1	1	3	3.71
q14d7_rc The MIS has resulted in reduced staff costs	3.00	1.633	0.617	4.861	6	0.003	1.49	4.51	7	2	1		3	1	3.00
q14d8_rc The MIS has resulted in cost reductions	3.71	1.380	0.522	7.120	6	0.000	2.44	4.99	7	1		1	3	2	3.71
User satisfaction															
q14e1_rc How often does the system provide the precise information you need?	4.33	1.211	0.494	8.765	5	0.000	3.06	5.60	6		1		1	4	4.33

MIS success evaluation constructs and underlying items (variables)	Mean	Std. Deviation	Std. Error Mean	t (Test Value = 0)	df	Sig. (2-tailed)	95% Confidence Interval of the Mean			Frequency of score					
							Lower	Upper	N	1	2	3	4	5	WAI
q14e2_rc How often does the system provide reports that seem to be just about exactly what you need?	4.17	1.169	0.477	8.730	5	0.000	2.94	5.39	6		1		2	3	4.17
q14e3_rc How often does the information content meet your needs?	4.83	0.408	0.167	29.000	5	0.000	4.40	5.26	6				1	5	4.83
q14e4_rc How often is the system accurate?	4.60	0.548	0.245	18.779	4	0.000	3.92	5.28	5				2	3	4.60
q14e5_rc How often are you satisfied with the accuracy of the system?	4.60	0.548	0.245	18.779	4	0.000	3.92	5.28	5				2	3	4.60
q14e6_rcrev Rev: How often have you detected inconsistencies and inaccuracies in the content of the output reports from the system?	2.40	1.673	0.748	3.207	4	0.033	0.32	4.48	5	2	1	1		1	2.40
q14e7_rc How often do you think the output is presented in a useful format?	4.33	0.816	0.333	13.000	5	0.000	3.48	5.19	6			1	2	3	4.33
q14e8_rc How often is the information clear?	4.50	0.837	0.342	13.175	5	0.000	3.62	5.38	6			1	1	4	4.50
q14e9_rc How often is the system user-friendly?	4.29	0.756	0.286	15.000	6	0.000	3.59	4.98	7			1	3	3	4.29
q14e10_rc How often is the system easy to use?	4.43	0.787	0.297	14.892	6	0.000	3.70	5.16	7			1	2	4	4.43
q14e11_rc How often do you get the information you need in time?	4.17	0.753	0.307	13.558	5	0.000	3.38	4.96	6			1	3	2	4.17
q14e12_rc How often does the system provide up-to-date information?	4.17	0.753	0.307	13.558	5	0.000	3.38	4.96	6			1	3	2	4.17
Overall assessment															
q14f1_rc Overall, how satisfied are you with the MIS in your working environment?	4.33	0.816	0.333	13.000	5	0.000	3.48	5.19	6			1	2	3	4.33
q14f2_rc Overall, how satisfied are you with using the MIS?	4.00	1.095	0.447	8.944	5	0.000	2.85	5.15	6		1		3	2	4.00
q14f3_rc Overall, how satisfied are you with the quality of the data captured within the MIS?	4.33	0.816	0.333	13.000	5	0.000	3.48	5.19	6			1	2	3	4.33
q14f4_rc Overall, how satisfied are you with the quality of the outputs from the MIS?	4.17	1.169	0.477	8.730	5	0.000	2.94	5.39	6		1		2	3	4.17
q14f5_rcrev Rev: How often are you prevented from or delayed in using the system due to computer errors, system crashes or other machine related problems?	2.33	1.366	0.558	4.183	5	0.009	0.90	3.77	6	1	4			1	2.33
q14f6_rcrev Rev: How often are you prevented from or delayed in using the system due to password problems?	2.60	1.673	0.748	3.474	4	0.025	0.52	4.68	5	2		2		1	2.60
q14f7_rcrev Rev: How often are you prevented from or delayed in using the system because the system is working too slowly?	2.20	1.643	0.735	2.994	4	0.040	0.16	4.24	5	2	2			1	2.20
q14f8a_rc The performance of our unit/department has become:	4.20	0.708	0.250	16.767	7	0.000	3.60	4.79	8			1	5	2	4.13
q14f8b_rc The quality of our unit's/department's work has become:	3.75	1.129	0.399	9.391	7	0.000	2.81	4.69	8	1		1	5	1	3.63
q14f9_rc The MIS is worth the time and effort to use it:	4.20	0.708	0.250	16.767	7	0.000	3.60	4.79	8			1	5	2	4.13

MIS success evaluation constructs and underlying items (variables)	Mean	Std. Deviation	Std. Error Mean	t (Test Value = 0)	df	Sig. (2-tailed)	95% Confidence Interval of the Mean			Frequency of score					
							Lower	Upper	N	1	2	3	4	5	WAI
q14f10 All considered how would you rate your satisfaction with the MIS in your unit/department?	4.50	0.535	0.189	23.812	7	0.000	4.05	4.95	8				4	4	4.50
q14f11 All considered how would you rate the success of the MIS in your unit/department?	4.50	0.535	0.189	23.812	7	0.000	4.05	4.95	8				4	4	4.50

Notes:

Df: Degrees of freedom; Sig: Statistically significant; WAI: Weighted Average Index

8.4.5.2. Preparation of data for the calculation of the MIS success evaluation constructs

For each MIS success evaluation construct, as listed in Table 8.6, the underlying items or variables were tested for unidimensionality (Principal Component Analysis [PCA]) (cf. section 2.7.3) (Pearson, 1901) and internal consistency (Cronbach's alpha scale reliability testing) (cf. section 2.7.4) (Cronbach, 1951). First-order underlying constructs were created and named, from the components that emerged from the tests for unidimensionality, and presented in Table 8.7. The variance explained by each set of components (calculated by using PCA) and the Reliability Statistic (Cronbach's Alpha) for each set of items that comprised a component is provided in Table 8.7. In all PCAs more than 82% of the variance was explained by the extracted components. The strength of the internal reliability of items within each extracted component was high in all instances, except for *costimpact* (Cronbach Alpha, α=0.462).

Statistical analyses were performed using IBM SPSS Statistics version 24 (SPSS an IBM Company, 2017) and the results were recorded in MS Excel 2010 (Microsoft, 2010). The IBM SPSS syntax file and the MS Excel file in which all these analyses were recorded are available on the compact disk provided with the thesis.

Table 8.7. Components extracted with PCA and reliability statistic of each MIS success evaluation construct, College 1.

MIS success evaluation construct	PCA - components extracted			Items	# of items	Cron. Alpha
	#	Var.	Named			
Individual impact	1	82.432	Individual impact	q14a2_rc The MIS enhances my awareness of job related information	5	0.928
				q14a4_rc The MIS enhances my effectiveness in the job		
				q14a3_rc The MIS enhances my recall of job related information		
				q14a5_rc The MIS increases my productivity		
				q14a1_rc I have learnt much through the presence of the MIS		
Information quality	2	96.385	Data quality	q14b11_rc Information from the MIS is always timely	7	0.893
				q14b1_rcrev Rev: Information available from the MIS is important		
				q14b2_rc The MIS contains all the key data that is needed		
				q14b6_rc Information needed from the MIS is always available		
				q14b9_rc Information from the MIS appears readable, clear and well formatted		
				q14b10_rc Information from the MIS is concise		
				q14b3_rc Information available from the MIS is always accurate (does		

MIS success evaluation construct	PCA - components extracted #	Var.	Named	Items	# of items	Cron. Alpha
				not often need correction)		
			Output quality	q14b8_rcrev Rev: Information from the MIS is easy to understand	4	0.762
				q14b4_rcrev Rev: Information from the MIS is updated and current		
				q14b5_rc The MIS provides output that seems to be exactly what is needed		
				q14b7_rc Information from the MIS is in a format that is readily usable		
System quality	3	88.386	Ease of access	q14c2_rc The MIS is easy to learn	5	0.908
				q14c6_rcrev Rev: The MIS includes necessary features and functions		
				q14c4_rc All data within the MIS is fully integrated and consistent		
				q14c7_rc The MIS always does what it should		
				q14c5_rc The MIS meets (the TVET College's) information requirements		
			Ease of function-ing	q14c8_rc The MIS user interface (screen) can be easily adapted to one's personal approach (customise)	5	0.972
				q14c12_rc Modifications to the functionality of the MIS can easily be done (modified, corrected and improved)		
				q14c11_rc The MIS requires only the minimum number of fields and screens to achieve a task		
				q14c9_rc The MIS is always up-and-running as necessary (It has good connectivity, e.g. to network, server access, etc.)		
				q14c10_rc The MIS programme speed is quick enough (responds quickly)		
Service quality	2	94.053	Service quality	q14c16_rc The MIS's service provider provides quality training	5	0.799
				q14c14_rc The MIS's service provider has up-to-date facilities		
				q14c15_rc The MIS's service provider is experienced		
				q14c13_rc The MIS's service provider is reliable		
				q14c17_rc The MIS's service provider provides quality services		
Organisa-tional impact	2	82.331	Produc-tivity	q14d3_rc The MIS has resulted in an increased capacity to manage a growing volume of activity (e.g transactions, population growth etc)	5	0.897
				q14d1_rc The MIS has resulted in overall productivity improvement		
				q14d5_rc The MIS has helped to improve communication and relationships		
				q14d4_rc The MIS has resulted in improved business processes		
				q14d2_rc The MIS has resulted in improved outcomes or outputs		
			Cost impact	q14d6_rc The MIS is cost effective	2	0.462
				q14d8_rc The MIS has resulted in cost reductions		
User satisfaction	3	95.173	Format	q14e7_rc How often do you think the output is presented in a useful format?	6	0.947
				q14e8_rc How often is the information clear?		
				q14e10_rc How often is the system easy to use?		
				q14e11_rc How often do you get the information you need in time?		
				q14e9_rc How often is the system user-friendly?		
				q14e12_rc How often does the system provide up-to-date information?		
			Content	q14e3_rc How often does the information content meet your needs?	3	0.897
				q14e1_rc How often does the system provide the precise information you need?		
				q14e2_rc How often does the system provide reports that seem to be just about exactly what you need?		
			Accuracy	q14e6_rcrev Rev: How often have you detected inconsistencies and inaccuracies in the content of the output reports from the system?	3	0.621
				q14e5_rc How often are you satisfied with the accuracy of the system?		
				q14e4_rc How often is the system accurate?		
Overall evaluation	3	100	Perform-ance and quality of data and output	q14f8a_rc All considered to what extent has the MIS changed the following two aspects of your own unit or department? Performance has become:	5	0.631
				q14f8b_rc All considered to what extent has the MIS changed the following two aspects of your own unit or department? Quality has		

MIS success evaluation construct	PCA - components extracted			Items	# of items	Cron. Alpha
	#	Var.	Named			
				become:		
				q14f1_rc Overall, how satisfied are you with the MIS in your working environment?		
				q14f3_rc Overall, how satisfied are you with the quality of the data captured within the MIS?		
				q14f4_rc Overall, how satisfied are you with the quality of the outputs from the MIS?		
			Function-ing of system	q14f10 All considered how would you rate your satisfaction with the MIS in your unit/department?	4	0.796
				q14f2_rc Overall, how satisfied are you with using the MIS?		
				q14f11 All considered how would you rate the success of the MIS in your unit/department?		
				q14f9_rc How much do you agree with the following statement? The MIS is worth the time and effort to use it:		
			System quality	q14f6_rcrev Rev: How often are you prevented from or delayed in using the system due to password problems?	3	0.976
				q14f7_rcrev Rev: How often are you prevented from or delayed in using the system because the system is working too slowly?		
				q14f5_rcrev Rev: How often are you prevented from or delayed in using the system due to computer errors, system crashes or other machine related problems?		

Notes:

1. 'Var. Exp.' means variance explained by components extracted.

2. # means number.

3. 'Cron. Alpha' means Reliability Statistic (Cronbach's Alpha)

4. The postfix: '_rc' means the item was recoded (code 6 as missing) and the postfix: '_rcrev' means that the item was recoded and the negative statement was reversed to a positive statement.

8.4.5.3. Creation and calculation of MIS success evaluation constructs

The MIS success evaluation constructs were calculated as follows:

- **Individual impact,** a first-order factor, was created by calculating the mean of five items (q14a1_rc, q14a2_rc, q14a3_rc, q14a4_rc, q14a5_rc);
- **Information quality,** a second-order factor, was created by calculating the mean of the eleven items that were used to create the two first-order factors:
  - o **Data quality,** a first-order factor, was created by calculating the mean of seven items (q14b1_rcrev, q14b2_rc, q14b3_rc, q14b6_rc, q14b9_rc, q14b10_rc, q14b11_rc).
  - o **Output quality,** a first-order factor, was created by calculating the mean of four items (q14b4_rcrev, q14b5_rc, q14b7_rc, q14b8_rcrev).

- **System quality,** a second-order factor, was created by calculating the mean of the ten items that were used to create the two first-order factors:
    - o **Ease of Access,** a first-order factor, was created by calculating the mean of five items (q14c2_rc, q14c4_rc, q14c5_rc, q14c6_rcrev, q14c7_rc, q14c8_rc).
    - o **Ease of Functioning,** a first-order factor, was created by calculating the mean of five items (q14c9_rc, q14c10_rc, q14c11_rc, q14c12_rc).
- **Service quality,** a first-order factor, was created by calculating the mean of five items (q14c13_rc, q14c14_rc, q14c15_rc, q14c16_rc, q14c17_rc);
- **Organisational impact,** a second-order factor, was created by calculating the mean of the seven items that were used to create the two first-order factors:
    - o **Productivity,** a first-order factor, was created by calculating the mean of five items (q14d1_rc, q14d2_rc, q14d3_rc, q14d4_rc, q14d5_rc).
    - o **Cost impact,** a first-order factor, was created by calculating the mean of two items (q14d6_rc, q14d8_rc).
- **User satisfaction,** a second-order factor, was created by calculating the mean of the twelve items that were used to create the three first-order factors:
    - o **Format,** a first-order factor, was created by calculating the mean of six items (q14e7_rc, q14e8_rc, q14e9_rc, q14e10_rc, q14e11_rc, q14e12_rc).
    - o **Content,** a first-order factor, was created by calculating the mean of three items (q14e1_rc, q14e2_rc, q14e3_rc).
    - o **Accuracy,** a first-order factor, was created by calculating the mean of three items (q14e4_rc, q14e5_rc, q14e6_rcrev).

As described in the previous paragraph, two variables were created from the constructs to denote overall evaluation of the MIS, namely:

- Average of all items (54 questions: q14a1 up to q14e12) across the six MIS success constructs (named: *avgitems*);

- Average of the calculated values of the six MIS success constructs (named: *avgconstr*).

Another set of questions (q14f1 to 14f11) required the participants to provide their overall perception of the quality, performance and success of the entire MIS. These items were included in the questionnaire as a verification measure to validate the responses to the MIS success constructs (cf. Appendix E). Responses to these questions were compared to the variables: *avgitems* and *avgconstr*. The following variables were created from these questions:

- **Overall evaluation,** a second-order factor, was created by calculating the mean of the twelve items that were used to create the four first-order components:
    - **Component 1** (Satisfaction with data, outputs and the use of the system), a first-order factor, was created by calculating the mean of four items (q14f1_rc, q14f2_rc, q14f3_rc, q14f4_rc).
    - **Component 2** (Satisfaction with the functioning of system), a first-order factor, was created by calculating the mean of three items (q14f5_rcrev, q14f6_rcrev, q14f7_rcrev).
    - **Component 3** (Success and value of the system), a first-order factor, was created by calculating the mean of three items (q14f9_rc, q14f10_rc, q14f11_rc).
    - **Component 4** (Performance and quality of work related to system), a first-order factor, was created by calculating the mean of two items (q14f8a_rc, q14f8b_rc).

Table 8.8 provides descriptive statistics for the MIS success evaluation constructs calculated as described above and Figure 8.4 graphically presents the measured MIS success constructs.

MIS users at College 1 perceived the information contained in the MIS (*Information quality*), including the data and outputs from the system, as valuable and what they needed, most of the time (Mean=4.30). The MIS success construct, *User satisfaction,* received the second highest mean score of 4.27, which indicates that users were almost always satisfied with the content, accuracy, timeliness and format of the data and the system's ease of use. MIS users rated the impact of the MIS on the organisation (Mean=3.95) and the support of the service provider (Mean=4.07) the lowest (cf. Figure 8.4). The MIS had been implemented recently (more or less than a year) and one could expect of users to perceive the impact of the system on the organisation as valuable over time as the system matures.

Table 8.8. Descriptive statistics of the MIS success evaluation constructs for College 1.

MIS Success Evaluation construct	N	Minimum	Maximum	Mean		Std. Deviation	Variance
	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Statistic
Individual impact	8	3.000	5.000	4.15	0.282	0.798	0.637
Information quality	8	3.364	5.000	4.30	0.182	0.514	0.265
System quality	7	3.000	5.000	4.13	0.294	0.778	0.605
Service quality	6	3.200	5.000	4.07	0.313	0.766	0.587
Organisational impact	8	3.375	4.625	3.95	0.152	0.430	0.185
User satisfaction	8	3.000	5.000	4.27	0.260	0.736	0.542
Overall evaluation	8	3.500	4.759	4.15	0.174	0.492	0.242
Valid N (listwise)	6						

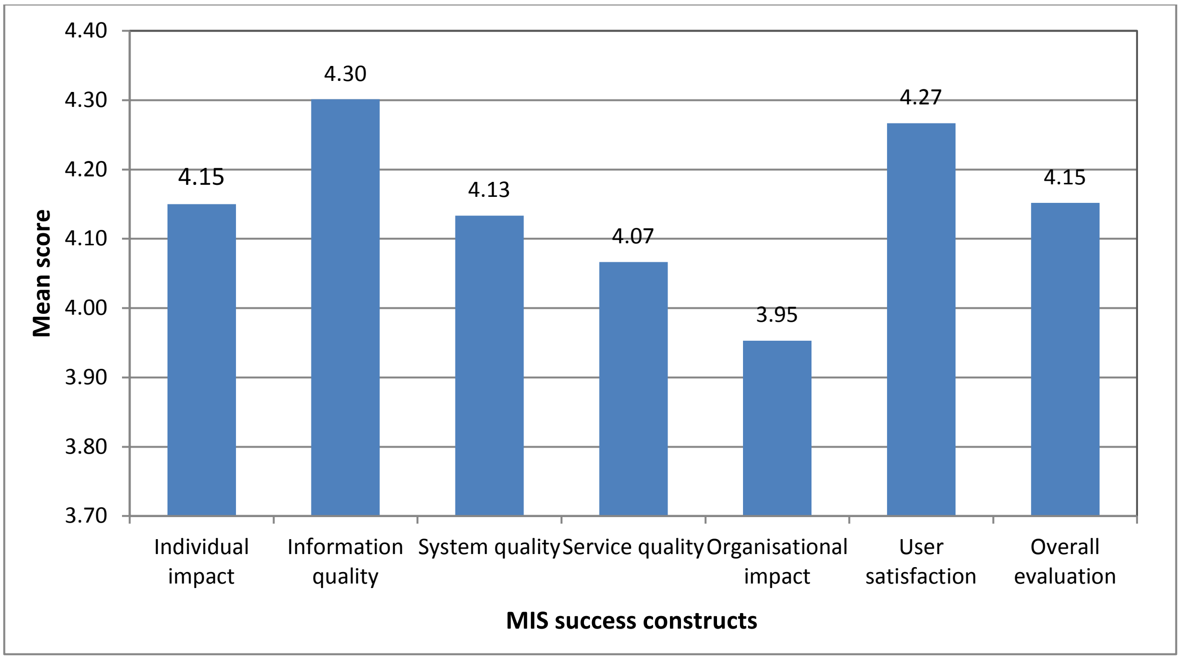


Figure 8.4. Mean scores for each MIS success construct for College 1.

The following section presents findings on an investigation into the relationships between the different measured MIS success constructs.

8.4.5.4. Relationship between the MIS success constructs and the overall evaluation of the MIS

Bivariate correlation procedures were performed to investigate the relationships between MIS success constructs and to investigate the relationships between the constructs as potential predictors, and the overall evaluation of the success of the MIS at College 1.

Kendall's tau-b (τb) correlation coefficient (Kendall, 1938) calculation procedures were utilised because it is a non-parametric measure of the strength and direction of association that exists between two variables measured on an ordinal or continuous scale (cf. Chapter 2, section 2.7.5). Pearson's product-moment correlation (Pearson, 1900) could not be used because the data is not normally distributed. Kendall's tau-b procedure was preferred to Spearman's rank-order correlation (Spearman, 1904) coefficient because the sample size (eight participants) was small with many tied ranks (Field, 2009, p. 175). The bivariate correlation coefficients are presented in Table 8.9.

Table 8.9. Kendall's tau_b correlation matrix of MIS success constructs for College 1.

Kendall's tau_b		Individual impact	Informa-tion quality	System quality	Service quality	Organisa-tional impact	User satisfac-tion	Overall evalua-tion
Individual impact	Correlation Coefficient	1.000						
	Sig. (2-tailed)							
	N	8						
Informa-tion quality	Correlation Coefficient	.725*	1.000					
	Sig. (2-tailed)	0.018						
	N	8	8					
System quality	Correlation Coefficient	0.620	.714*	1.000				
	Sig. (2-tailed)	0.071	0.024					
	N	7	7	7				
Service quality	Correlation Coefficient	0.418	0.501	.788*	1.000			
	Sig. (2-tailed)	0.289	0.173	0.032				
	N	6	6	6	6			
Organisa-tional impact	Correlation Coefficient	-0.242	-0.071	0.143	0.501	1.000		
	Sig. (2-tailed)	0.431	0.805	0.652	0.173			
	N	8	8	7	6	8		
User satisfac-tion	Correlation Coefficient	0.492	.764**	.683*	0.501	0.182	1.000	
	Sig. (2-tailed)	0.113	0.009	0.033	0.173	0.533		
	N	8	8	7	6	8	8	
Overall evalua-tion	Correlation Coefficient	0.483	.714*	.714*	0.645	0.214	.837**	1.000
	Sig. (2-tailed)	0.115	0.013	0.024	0.079	0.458	0.004	
	N	8	8	7	6	8	8	8

*. Correlation is significant at the 0.05 level (2-tailed).
**. Correlation is significant at the 0.01 level (2-tailed).

The following strong, statistically significant, positive correlations between MIS success constructs were observed (Table 8.9):

- between *individual impact* and *information quality* (τb = .725, p = .018);
- between *information quality* and *system quality* (τb = .714, p = .024);
- between *system quality* and *service quality* (τb = .788, p = .032);
- between *information quality* and *user satisfaction* (τb = .764, p = .009);
- between *system quality* and *user satisfaction* (τb = .683, p = .033);
- between *information quality* and *overall evaluation* (τb = .714, p = .013);
- between *system quality* and *overall evaluation* (τb = .714, p = .024);
- between *user satisfaction* and *overall evaluation* (τb = .837, p = .004).

In summary, as depicted in Figure 8.5, the data showed that *service quality* was positively correlated with *system quality*, which was positively correlated with *information quality, service quality*, *user satisfaction* and *overall evaluation*. *Information quality* positively correlated with *individual impact, system quality, user satisfaction* and *overall evaluation*.

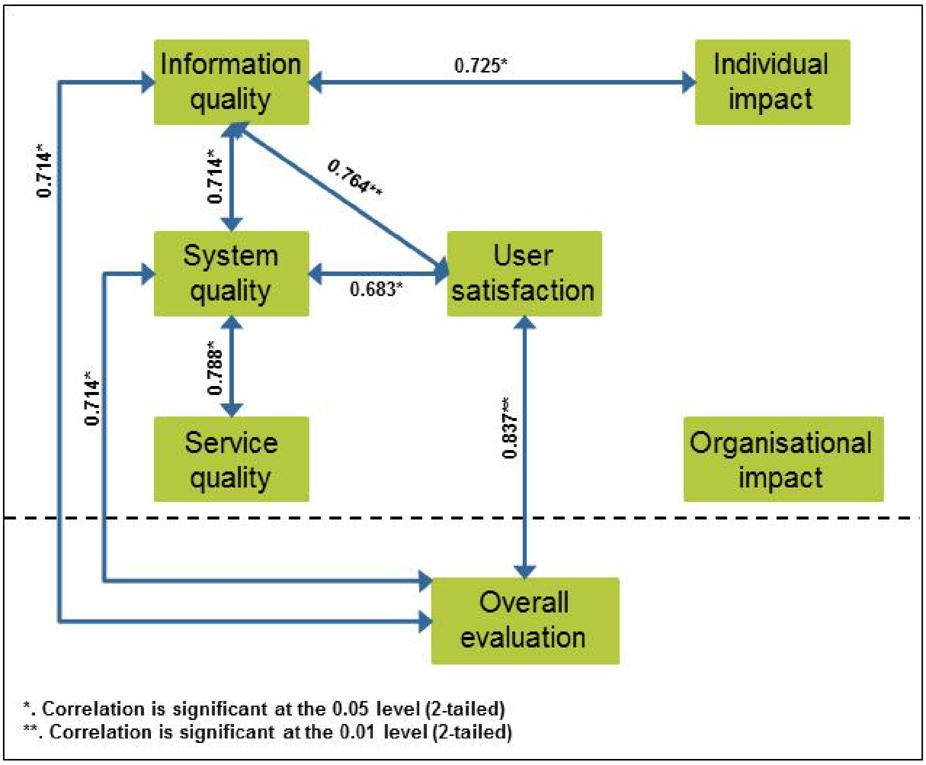


Figure 8.5. Statistically significant positive relationships between MIS success constructs for College 1.

No correlation between *organisational impact* and any other MIS success construct was observed. The fact that no statistically significant relationship between *organisational impact* and any other construct was observed could be related to the age of the system – it had only been implemented and used for a year. The impact of the MIS on the organisation might become more visible over time.

8.4.5.5. Investigate predictor value of constructs with regression analysis

The predictor value of the MIS success constructs to predict the independent variable, *overall evaluation*, was investigated with linear regression analysis.

The dependent variable was firstly tested for normality, which is an assumption for linear regression analysis. A Shapiro-Wilk test (Shapiro & Wilk, 1965) was used to test for normality on the dependent variable, *overall evaluation* (cf. Chapter 2, section 2.7.6). The *overall evaluation* variable, $D(8) = 0.903$, $p > 0.05$, was not significant, indicating that the data was normally distributed.

Multiple regression analyses require a large number of observations. The number of cases must exceed the number of predictor variables utilised in the regression. The number must be at least five times as many participants as predictor variables (Field, 2009). Only eight responses were received for College 1, therefore the regression can include, at the most, one predictor variable – therefore it was decided to perform simple regression analyses by using one MIS success construct at a time.

Each MIS success construct was separately investigated with single regression analyses. The single regression models for the predictors, *individual impact*, *information quality*, *system quality*, *service quality* and *user satisfaction* significantly predicted the dependent variable, *overall evaluation*. It was thus decided to include all the MIS success construct variables in multiple regression analyses, in which the Stepwise method was utilised (cf. Chapter 2, section 2.7.7) (Brace, Kemp & Snelgar, 2012).

The analyses produced two significant models as presented in Table 8.10.

Model 1: The variable *user satisfaction* explained 91% of the variance in the *overall evaluation* of the MIS (R^2 = 0.928, Adjusted R^2 = 0.910). The results in the ANOVA section shows that in this model, *user satisfaction* predicted *overall evaluation* of the MIS significantly well (F = 51.753, $p<0.05$). For each unit of change in the independent variable (*user satisfaction*), the dependent variable (*overall evaluation*), will increase with 0.697 score points ($\beta = 0.697$, $p<0.05$). Thus, *user satisfaction* is a significant predictor of the *overall evaluation* of the MIS at College 1.

Model 2: The variables *user satisfaction* and *service quality* explained 98% of the variance in the *overall evaluation* of the MIS (R^2 = 0.993, Adjusted R^2 = 0.988). The results in the ANOVA section show that in this model, *user satisfaction* and *service quality* predicted *overall evaluation* of the MIS significantly well (F = 205.334, $p<0.05$). In this model, *user satisfaction* has stronger predictor value than *service quality* (standardised beta coefficients of [$\beta = 0.713$, $p<0.05$] and [β = 0.357, $p<0.05$] respectively). When controlling for *service quality*, each unit of increase in the independent variable, *user satisfaction,* will result in an increase of 0.515 score points ($\beta = 0.515$, $p<0.05$) in the dependent variable (*overall evaluation*). Similarly, when controlling for *user satisfaction*, each unit increase in *service quality* will result in an increase of 0.248 score points ($\beta = 0.248$, $p<0.05$) in the dependent variable (*overall evaluation*). Thus, *user satisfaction* and *service quality* are significant predictors of the *overall evaluation* of the MIS at College 1.

Table 8.10. Results of a regression analysis with *overall assessment* as the dependent variable and *MIS success construct variables* as independent variables, College 1.

Model Summary				
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.963[a]	0.928	0.910	0.15921994
2	.996[b]	0.993	0.988	0.05845281
a. Predictors: (Constant), user satisfaction				
b. Predictors: (Constant), user satisfaction, service quality				

ANOVA[a]						
Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	1.312	1	1.312	51.753	.002[b]
	Residual	0.101	4	0.025		
	Total	1.413	5			
2	Regression	1.403	2	0.702	205.334	.001[c]
	Residual	0.010	3	0.003		
	Total	1.413	5			
a. Dependent Variable: overall evaluation						
b. Predictors: (Constant), user satisfaction						
c. Predictors: (Constant), user satisfaction, service quality						

Coefficients[a]						
Model		Unstandardised		Standardised	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	1.247	0.398		3.132	0.035
	User satisfaction	0.697	0.097	0.963	7.194	0.002
2	(Constant)	0.974	0.155		6.270	0.008
	User satisfaction	0.515	0.050	0.713	10.323	0.002
	Service quality	0.248	0.048	0.357	5.165	0.014
a. Dependent Variable: Overall evaluation						

Excluded Variables[a]						
Model		Beta In	t	Sig.	Partial Correlation	Collinearity Statistics Tolerance
1	Individual impact	.003[b]	0.006	0.996	0.003	0.112
	Information quality	-.547[b]	-1.870	0.158	-0.734	0.129
	System quality	.402[b]	3.086	0.054	0.872	0.337
	Service quality	.357[b]	5.165	0.014	0.948	0.507
	Organisational impact	.153[b]	1.192	0.319	0.567	0.981
2	Individual impact	-.208[c]	-1.827	0.209	-0.791	0.105
	Information quality	.396[c]	1.661	0.239	0.761	0.027
	System quality	.177[c]	2.010	0.182	0.818	0.156
	Organisational impact	-.019[c]	-0.244	0.830	-0.170	0.577
a. Dependent Variable: Overall evaluation						
b. Predictors in the Model: (Constant), user satisfaction						
c. Predictors in the Model: (Constant), user satisfaction, service quality						

The following section presents findings and observations regarding the application of Phases C and D of the TVET-MIS-EVAL methodology on College 2.

8.5. College 2: Findings transpired from the application of Phase C: Procedures and Phase D: Toolkit of the TVET-MIS-EVAL methodology

The findings from qualitative and quantitative data analyses with regard to College 2 are presented in this section. A semi-structured interview was conducted with the curriculum manager of the college, who was also responsible for managing the MIS data on student and examination administration. Fourteen out of a possible sixteen MIS users, completed the survey questionnaire (cf. Appendix E). Thus, a response rate of 88% was achieved.

8.5.1. Qualitative data and information

The interview with the curriculum manager yielded extremely rich qualitative data. The interview was recorded with a digital recorder and covered more subject matter than was proposed in the semi-structured interview schedule (cf. Appendix D).

According to the interviewee, only two senior staff members had been given access rights to all MIS component functions (components included student administration, academic administration, financial administration, human resource management and development, asset management, and technical administration and maintenance). Access to data capturing rights was granted to a limited number of staff. The reason for the decision to strictly control the different access rights was to limit fraud and ensure privacy and confidentiality of data and information according to the Protection of Personal Information (POPI) act (Republic of South Africa, 2013; Interviewee 4, 2015). The college had previously allowed education specialists to capture their own test marks on the system, with catastrophic results. Much work had to be redone because lecturers had overwritten other lecturer’s test marks (Interviewee 4, 2015). Almost 80 staff members across the six sites (main campus, four campuses and workshop) had viewing and querying rights on the system, but working on and maintenance of the MIS did not form part of their day-to-day working responsibilities.

At the time of the interview, the college had been using the MIS for 13 years and was very satisfied with its performance, as well as with the support and quality of the service provider. The service provider had been very responsive to changes in the data requirement and strategies of the DHET and had provided the college with frequent and timely updates to the system when necessary. The service provider was accommodating in providing assistance with dashboard queries when the users were not able to compile the queries themselves.

According to the interviewee, the most important official documents that inform the MIS are the strategic plan (DHET, 2015c), the operational plan (DHET, 2015a) and the annual performance plan (DHET, 2016a) of the DHET. The MIS had been aligned with the specifications of data requirements of the DHET and the outputs match the templates provided by DHET.

It was furthermore emphasised that intensive data quality assurance activities have been centralised at the main campus. Campuses upload their data to the system via the network, data queries are run at the main campus and the output reports are then sent back to the campuses for verification and then signed off. The most appropriate dataset needs to be used for a query and the interpretation of the requests has to be standardised. It sometimes happens that campuses use the wrong dataset to respond to a query from DHET or from the main campus.

Additional qualitative findings will be integrated where applicable in the quantitative findings presented in the following sections. The following section presents information on the demographic profile of the MIS users at College 2.

8.5.2. Demographics of MIS users

Data analysis of the survey administered to users of the MIS at College 2 revealed the following results:

- Almost four-fifths (79%) of the MIS users were female and 21% were male;
- More than three-quarters (77%) of the MIS users were older than 30 years of age – 23% were 40 years or older;
- The highest level of education of 15% of the respondents was a degree or higher qualifications. The rest of the respondents had a diploma or advanced certificate (69%), or a higher certificate (15%);
- 14% of the users were management and 86% support staff;
- 92% were full-time and 8% part-time employees;
- The majority of the users were key-users (54%) – the rest end-users;
- 85% of the users were permanent and 15% fixed-term employees;
- 29% of all users had less than five years of working experience in total and 36% had less than five years working experience at the college; and
- 86% of the users received training on the MIS, of which 64% received in-house training as well as training from the external service provider.

8.5.3. Computer proficiency of users

A series of questions (questions 11a to 11e) in the survey questionnaire investigated the level of computer proficiency of MIS users. A Principal Component Analysis (PCA) of these items extracted two components as depicted in Tables 8.11 and 8.12. The extracted components explained 66.8% of the total variance in the sample (Table 8.11).

Table 8.11. Principal Component Analysis (PCA): Total variance explained.

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	2.357	39.286	39.286	2.357	39.286	39.286	2.354	39.235	39.235
2	1.653	27.552	66.839	1.653	27.552	66.839	1.656	27.604	66.839
3	0.972	16.198	83.037						
4	0.515	8.583	91.620						
5	0.321	5.355	96.975						

Extraction Method: Principal Component Analysis.

A variable for computer proficiency was generated by using the responses to these questions as follows: firstly, the averages of the extracted components were calculated (i.e. average for questions q11c, q11d and q11b called *CompSkills*; average for questions q12, q11e and 11a called *TechSkills*); and secondly, the average of *CompSkills and TechSkills* was calculated. The final variable was called *CompProf* (computer proficiency).

Table 8.12. Principal Component Analysis: Extracted components.

	Component	
	1	2
q11c_word Competency in MS Word?	.887	
q11d_excel Competency in MS Excel?	.864	
q11b_comp Competency in computer skills?	.724	
q12_web Competency in technical skills?		.809
q11e_email Competency in email software?		.650
q11a_tech Competency in technical skills?		.644

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalisation.
a. Rotation converged in 3 iterations.

All respondents had above average levels of computer proficiency: eight users were scored the value four, which is above average, whilst six users scored themselves the value five, which related to an excellent computer proficiency level.

The following section presents information about the users' involvement with the MIS.

8.5.4. Extent of use of the MIS

In College 2 no lecturing staff were involved with maintaining and operating the MIS, only two management staff members worked on the system, of which one had access and worked on five components of the system (Table 8.13).

Table 8.13. Position of staff by number of components used daily, College 2.

Position of staff	One component	Two components	Three components	Four components	Five components	Total
Management staff	0	1	0	0	1	2
Support staff	3	6	2	1	0	12
Total	3	7	2	1	1	14

Most of the users were involved in student (twelve users) and examination (ten users) registration activities, one person was responsible for financial administration and five users were responsible for technical administration and the maintenance of the MIS (Figure 8.6).

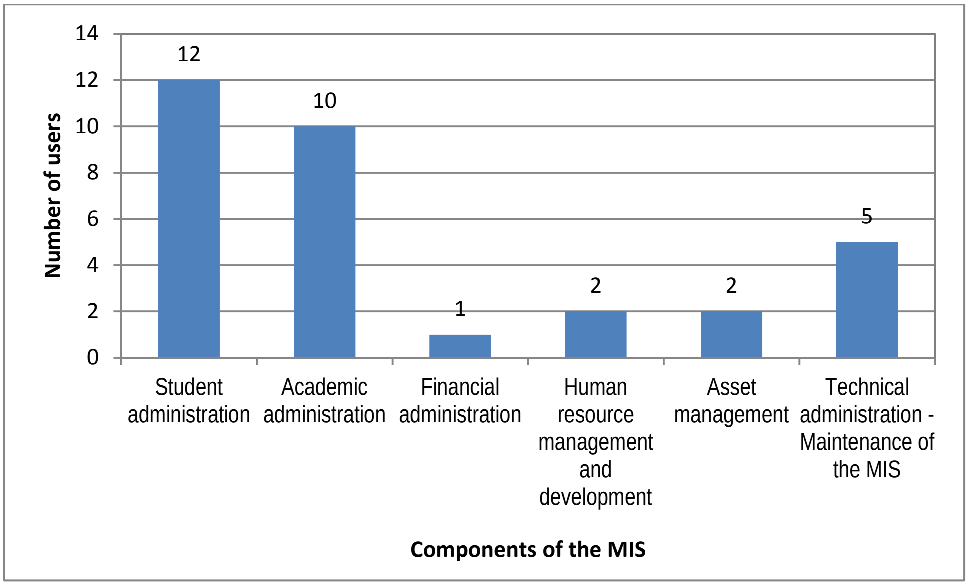


Figure 8.6. Number of users by MIS component, College 2.

Only one user had access and used five components of the MIS, while eleven users used, at the most, two components (Figure 8.7).

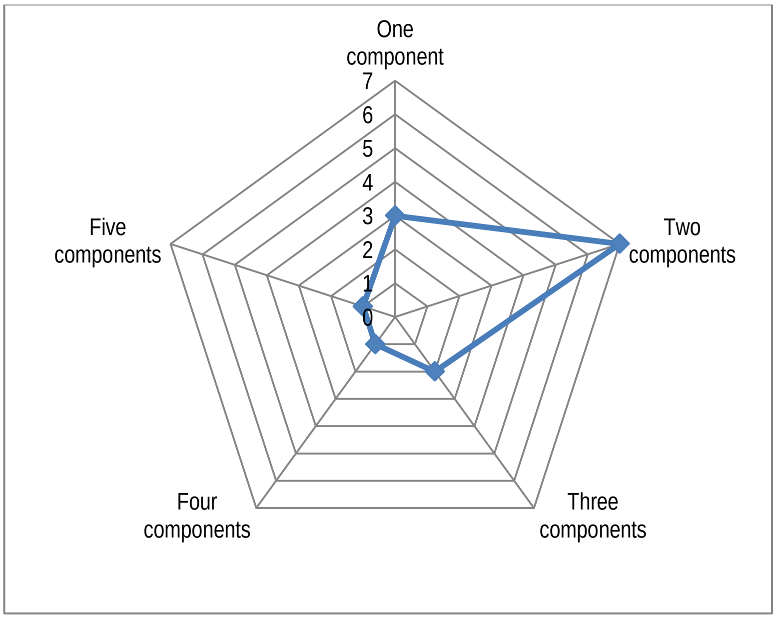


Figure 8.7. Distribution of MIS users by extent of use, College 2.

Sections 8.5.1, 8.5.2 and 8.5.3 reported on the profile of the MIS users for the purpose of understanding the user context of the setting in which the MIS is utilised. The following section will focus on the evaluation of the MIS itself.

8.5.5. Evaluation of MIS

The items contained within the instruments concerning the evaluation of the MIS were discussed in detail in the introduction of section 8.4.5. To avoid duplication, please refer to section 8.4.5 for background information regarding the MIS success constructs and their underlying items. The following section provides statistics with regard to individual MIS success evaluation items, which underlie the MIS success constructs.

8.5.5.1. Statistical significance and Weighted Average Index (WAI)

The confidence interval for each item in the questionnaire related to the success evaluation constructs (i.e. Information quality, Systems quality, Service quality, User Satisfaction, Individual impact and Organisational impact) of the MIS was calculated and revealed that all variables were statistically significant at the 95% confidence level, with t-values above 1.96 and p-values below 0.05, as presented in Table 8.14.

Weighted average indices and means were calculated for each item and presented in Table 8.14. The means varied from a maximum of 4.45 (for the item: *Information from the MIS is important*) to a minimum of 2.77 (for the item: *The MIS user interface [screen] can be easily adapted to one's personal approach [customise]*).

The ten highest rated items were related to *individual impact* and *information quality*. Users reported that the MIS enhanced their effectiveness (Mean=4.42) in the job, increased their productivity (Mean=4.38), and enhanced their recall of job related information (Mean=4.27) almost always. MIS users furthermore appreciated the information and format of the output reports from the system, the following item scores attest thereto: *Information from the MIS is important* (Mean=4.45), *The MIS contains all the key data that is needed* (Mean=4.42), *The MIS provides output that seems to be exactly what is needed* (Mean=4.42), *Information from the MIS appears readable, clear and well formatted* (Mean=4.36), *The system provides the precise information that is needed* (Mean=4.29).

The ten lowest rated MIS success evaluation items were mostly related to *system quality*. The data showed that MIS users experienced difficulty to access information within the system (Mean=3.46), the programme speed was not quick enough (Mean=3.36), it was difficult to do modifications to the functionality of the system (Mean=3.29), the user interface could not easily be adapted (Mean=2.77).

Figure 8.8 depicts the frequency with which the different scores between one and five on the Likert rating scale were selected across all MIS success evaluation items. Almost three-quarters of the scores (71%) was a four or a five, which indicates that the system performed well most of the time for 71% of the evaluated items. Scores of three and below (for 29% of items) can be considered a below average performance.

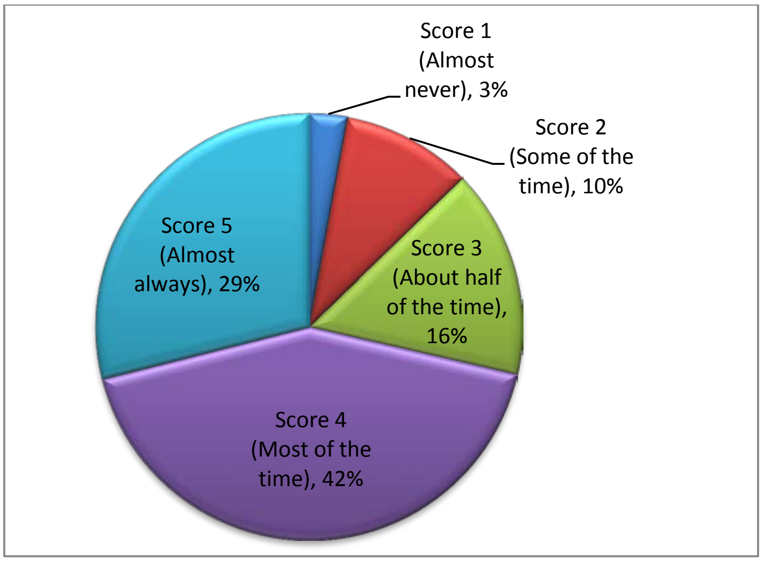


Figure 8.8. Distribution of participants' scores across all MIS evaluation items for College 2.

Table 8.14. Statistics with regard to the items/variables used in the success evaluation of the MIS at College 2.

MIS success evaluation constructs and underlying items (variables)	Mean	Std. Deviation	Std. Error Mean	t (Test Value = 0)	df	Sig. (2-tailed)	95% Confidence Interval of the Mean			Frequency of score					
							Lower	Upper	N	1	2	3	4	5	WAI
Individual impact															
q14a1_rc I have learnt much through the presence of the MIS	4.17	0.937	0.271	15.397	11	0.000	3.57	4.76	12		1	1	5	5	4.17
q14a2_rc The MIS enhances my awareness of job related information	4.17	0.577	0.167	25.000	11	0.000	3.80	4.53	12			1	8	3	4.17
q14a3_rc The MIS enhances my recall of job related information	4.27	0.786	0.237	18.024	10	0.000	3.74	4.80	11			2	4	5	4.27
q14a4_rc The MIS enhances my effectiveness in the job	4.42	0.669	0.193	22.885	11	0.000	3.99	4.84	12			1	5	6	4.42
q14a5_rc The MIS increases my productivity	4.38	0.768	0.213	20.586	12	0.000	3.92	4.85	13			2	4	7	4.38
Information quality															
q14b1_rcrev Rev: Information available from the MIS is not important	4.45	0.688	0.207	21.488	10	0.000	3.99	4.92	11			1	4	6	4.45
q14b2_rc The MIS contains all the key data that is needed	4.42	0.900	0.260	16.993	11	0.000	3.84	4.99	12		1		4	7	4.42
q14b3_rc Information available from the MIS is always accurate (does not often need correction)	3.86	1.027	0.275	14.051	13	0.000	3.26	4.45	14	1		2	8	3	3.86
q14b4_rcrev Rev: Information from the MIS is never updated and current	4.17	1.193	0.345	12.094	11	0.000	3.41	4.92	12	1		1	4	6	4.17
q14b5_rc The MIS provides output that seems to be exactly what is needed	4.42	0.515	0.149	29.712	11	0.000	4.09	4.74	12				7	5	4.42
q14b6_rc Information needed from the MIS is always available	3.69	1.109	0.308	12.000	12	0.000	3.02	4.36	13		3	1	6	3	3.69
q14b7_rc Information from the MIS is in a format that is readily usable	4.14	0.864	0.231	17.932	13	0.000	3.64	4.64	14			4	4	6	4.14
q14b8_rcrev Rev: Information from the MIS is not easy to understand	3.79	1.424	0.381	9.948	13	0.000	2.96	4.61	14	2	1		6	5	3.79
q14b9_rc Information from the MIS appears readable, clear and well formatted	4.36	1.082	0.289	15.070	13	0.000	3.73	4.98	14		2		3	9	4.36
q14b10_rc Information from the MIS is concise	4.23	0.927	0.257	16.459	12	0.000	3.67	4.79	13		1	1	5	6	4.23
q14b11_rc Information from the MIS is always timely	3.43	1.284	0.343	9.992	13	0.000	2.69	4.17	14	1	3	2	5	3	3.43
q14b12_rc Information from the MIS is unavailable elsewhere	3.00	1.301	0.348	8.629	13	0.000	2.25	3.75	14	2	3	4	3	2	3.00
System quality															
q14c1_rcrev Rev: The MIS is not easy to use	3.85	1.345	0.373	10.314	12	0.000	3.03	4.66	13	1	1	3	2	6	3.85
q14c2_rc The MIS is easy to learn	4.07	0.829	0.221	18.382	13	0.000	3.59	4.55	14			4	5	5	4.07
q14c3_rc It is not difficult to get access to information that is in the MIS	3.46	1.450	0.402	8.607	12	0.000	2.59	4.34	13	2	1	3	3	4	3.46
q14c4_rc All data within the MIS is fully integrated and consistent	4.14	0.949	0.254	16.330	13	0.000	3.59	4.69	14		1	2	5	6	4.14
q14c5_rc The MIS meets (the TVET College's) information requirements	3.92	0.954	0.265	14.826	12	0.000	3.35	4.50	13		1	3	5	4	3.92

MIS success evaluation constructs and underlying items (variables)	Mean	Std. Deviation	Std. Error Mean	t (Test Value = 0)	df	Sig. (2-tailed)	95% Confidence Interval of the Mean			Frequency of score					
							Lower	Upper	N	1	2	3	4	5	WAI
q14c6_rcrev Rev: The MIS does not include necessary features and functions	3.58	1.443	0.417	8.600	11	0.000	2.67	4.50	12	1	3		4	4	3.58
q14c7_rc The MIS always does what it should	3.31	1.437	0.398	8.301	12	0.000	2.44	4.18	13	2	2	2	4	3	3.31
q14c8_rc The MIS user interface (screen) can be easily adapted to one's personal approach (customise)	2.77	1.166	0.323	8.565	12	0.000	2.06	3.47	13	2	3	5	2	1	2.77
q14c9_rc The MIS is always up-and-running as necessary (It has good connectivity, e.g. to network, server access, etc.)	3.64	1.216	0.325	11.212	13	0.000	2.94	4.34	14	1	2	1	7	3	3.64
q14c10_rc The MIS programme speed is quick enough (responds quickly)	3.36	1.277	0.341	9.833	13	0.000	2.62	4.09	14	1	3	3	4	3	3.36
q14c11_rc The MIS requires only the minimum number of fields and screens to achieve a task	3.79	1.051	0.281	13.479	13	0.000	3.18	4.39	14		3		8	3	3.79
q14c12_rc Modifications to the functionality of the MIS can easily be done (modified, corrected and improved)	3.29	0.994	0.266	12.362	13	0.000	2.71	3.86	14		4	3	6	1	3.29
Service quality															
q14c13_rc The MIS's service provider is reliable	3.77	0.725	0.201	18.745	12	0.000	3.33	4.21	13			5	6	2	3.77
q14c14_rc The MIS's service provider has up-to-date facilities	3.23	1.166	0.323	9.992	12	0.000	2.53	3.94	13	1	2	5	3	2	3.23
q14c15_rc The MIS's service provider is experienced	4.00	0.739	0.213	18.762	11	0.000	3.53	4.47	12			3	6	3	4.00
q14c16_rc The MIS's service provider provides quality training	3.80	1.033	0.327	11.635	9	0.000	3.06	4.54	10		2		6	2	3.80
q14c17_rc The MIS's service provider provides quality services	3.69	1.316	0.365	10.119	12	0.000	2.90	4.49	13		4	1	3	5	3.69
Organisational impact															
q14d1_rc The MIS has resulted in overall productivity improvement	3.79	0.893	0.239	15.870	13	0.000	3.27	4.30	14			7	3	4	3.79
q14d2_rc The MIS has resulted in improved outcomes or outputs	4.07	0.730	0.195	20.867	13	0.000	3.65	4.49	14			3	7	4	4.07
q14d3_rc The MIS has resulted in an increased capacity to manage a growing volume of activity (e.g. transactions, population growth etc.)	3.79	0.893	0.239	15.870	13	0.000	3.27	4.30	14		1	4	6	3	3.79
q14d4_rc The MIS has resulted in improved business processes	3.79	0.975	0.261	14.529	13	0.000	3.22	4.35	14		1	5	4	4	3.79
q14d5_rc The MIS has helped to improve communication and relationships	3.57	1.089	0.291	12.266	13	0.000	2.94	4.20	14		2	6	2	4	3.57
q14d6_rc The MIS is cost effective	3.64	0.924	0.279	13.047	10	0.000	3.02	4.26	11		1	4	4	2	3.64
q14d7_rc The MIS has resulted in reduced staff costs	3.45	1.128	0.340	10.156	10	0.000	2.70	4.21	11	1	1	2	6	1	3.45
q14d8_rc The MIS has resulted in cost reductions	3.90	1.101	0.348	11.207	9	0.000	3.11	4.69	10		1	3	2	4	3.90
User satisfaction															
q14e1_rc How often does the system provide the precise information you need?	4.29	0.611	0.163	26.234	13	0.000	3.93	4.64	14			1	8	5	4.29

MIS success evaluation constructs and underlying items (variables)	Mean	Std. Deviation	Std. Error Mean	t (Test Value = 0)	df	Sig. (2-tailed)	95% Confidence Interval of the Mean			Frequency of score					
							Lower	Upper	N	1	2	3	4	5	WAI
q14e2_rc How often does the system provide reports that seem to be just about exactly what you need?	4.00	0.555	0.148	26.981	13	0.000	3.68	4.32	14			2	10	2	4.00
q14e3_rc How often does the information content meet your needs?	4.23	0.725	0.201	21.040	12	0.000	3.79	4.67	13			2	6	5	4.23
q14e4_rc How often is the system accurate?	4.21	0.975	0.261	16.173	13	0.000	3.65	4.78	14		1	2	4	7	4.21
q14e5_rc How often are you satisfied with the accuracy of the system?	4.00	0.877	0.234	17.065	13	0.000	3.49	4.51	14		1	2	7	4	4.00
q14e6_rcrev Rev: How often have you detected inconsistencies and inaccuracies in the content of the output reports from the system?	2.93	1.207	0.322	9.081	13	0.000	2.23	3.63	14	1	5	4	2	2	2.93
q14e7_rc How often do you think the output is presented in a useful format?	3.86	0.864	0.231	16.695	13	0.000	3.36	4.36	14		1	3	7	3	3.86
q14e8_rc How often is the information clear?	4.00	1.038	0.277	14.422	13	0.000	3.40	4.60	14		2	1	6	5	4.00
q14e9_rc How often is the system user-friendly?	4.07	0.829	0.221	18.382	13	0.000	3.59	4.55	14		1	1	8	4	4.07
q14e10_rc How often is the system easy to use?	4.21	0.802	0.214	19.667	13	0.000	3.75	4.68	14		1		8	5	4.21
q14e11_rc How often do you get the information you need in time?	4.00	0.679	0.182	22.030	13	0.000	3.61	4.39	14			3	8	3	4.00
q14e12_rc How often does the system provide up-to-date information?	4.00	0.784	0.210	19.079	13	0.000	3.55	4.45	14		1	1	9	3	4.00
Overall assessment															
q14f1_rc Overall, how satisfied are you with the MIS in your working environment?	4.00	1.038	0.277	14.422	13	0.000	3.40	4.60	14		2	1	6	5	4.00
q14f2_rc Overall, how satisfied are you with using the MIS?	4.14	0.770	0.206	20.123	13	0.000	3.70	4.59	14		1		9	4	4.14
q14f3_rc Overall, how satisfied are you with the quality of the data captured within the MIS?	4.21	1.051	0.281	15.005	13	0.000	3.61	4.82	14		2		5	7	4.21
q14f4_rc Overall, how satisfied are you with the quality of the outputs from the MIS?	4.07	0.730	0.195	20.867	13	0.000	3.65	4.49	14		1		10	3	4.07
q14f5_rcrev Rev: How often are you prevented from or delayed in using the system due to computer errors, system crashes or other machine related problems?	3.07	1.269	0.339	9.057	13	0.000	2.34	3.80	14	1	5	2	4	2	3.07
q14f6_rcrev Rev: How often are you prevented from or delayed in using the system due to password problems?	3.29	1.541	0.412	7.980	13	0.000	2.40	4.18	14	2	3	3	1	5	3.29
q14f7_rcrev Rev: How often are you prevented from or delayed in using the system because the system is working too slowly?	2.79	1.251	0.334	8.329	13	0.000	2.06	3.51	14	2	5	2	4	1	2.79
q14f8a_rc The performance of our unit/department has become:	4.07	0.536	0.149	27.326	12	0.000	3.74	4.39	13			1	11	1	4.00
q14f8b_rc The quality of our unit's/department's work has become:	4.01	0.362	0.100	39.984	12	0.000	3.79	4.23	13				13		4.00
q14f9_rc The MIS is worth the time and effort to use it:	4.07	0.677	0.188	21.665	12	0.000	3.66	4.47	13			2	9	2	4.00

MIS success evaluation constructs and underlying items (variables)	Mean	Std. Deviation	Std. Error Mean	t (Test Value = 0)	df	Sig. (2-tailed)	95% Confidence Interval of the Mean			Frequency of score					
							Lower	Upper	N	1	2	3	4	5	WAI
q14f10 All considered how would you rate your satisfaction with the MIS in your unit/department?	3.92	0.641	0.178	22.084	12	0.000	3.54	4.31	13			3	8	2	3.92
q14f11 All considered how would you rate the success of the MIS in your unit/department?	4.00	0.577	0.160	24.980	12	0.000	3.65	4.35	13			2	9	2	4.00

Notes:

Df: Degrees of freedom; Sig: Statistically significant; WAI: Weighted Average Index

8.5.5.2. Preparation of data for the calculation of the MIS success evaluation constructs

For each MIS success evaluation construct, as listed in Table 8.14, the underlying items or variables were tested for unidimensionality (Principal Component Analysis [PCA]) (cf. section 2.7.3) (Pearson, 1901) and internal consistency (Cronbach's alpha scale reliability testing) (cf. section 2.7.4) (Cronbach, 1951). First-order underlying constructs were created and named, from the components that emerged from the tests for unidimensionality, and presented in Table 8.15. The variance explained by each set of components (calculated by using PCA) and the Reliability Statistic (Cronbach's Alpha) for each set of items that comprised a component is provided in Table 8.15. In all PCAs more than 64% of the variance was explained by the extracted components. The strength of the internal reliability of items within each extracted component was high in most instances. Detailed notes on the extracted components are presented in section 8.5.5.3.

Statistical analyses were performed by using IBM SPSS Statistics version 24 (SPSS an IBM Company, 2017) and the results were recorded in MS Excel 2010 (Microsoft, 2010). The IBM SPSS syntax file and the MS Excel file in which all these analyses were recorded are available on the compact disk provided with the thesis.

Table 8.15. Components extracted with PCA and reliability statistic of each MIS success evaluation construct, College 2.

MIS success evalua-tion construct	PCA - components extracted			Items	# of items	Cron. Alpha
	#	Var.	Named			
Individual impact	2	78.380	Awareness	q14a1_rc I have learnt much through the presence of the MIS	2	0.824
				q14a2_rc The MIS enhances my awareness of job related information		
			Productivity	q14a5_rc The MIS increases my productivity	3	0.717
				q14a3_rc The MIS enhances my recall of job related information		
				q14a4_rc The MIS enhances my effectiveness in the job		
Informa-tion quality	3	80.821	Information format	q14b6_rc Information needed from the MIS is always available	6	0.842
				q14b10_rc Information from the MIS is concise		
				q14b11_rc Information from the MIS is always timely		
				q14b9_rc Information from the MIS appears readable, clear and well formatted		
				q14b7_rc Information from the MIS is in a format that is readily usable		
				q14b12_rc Information from the MIS is unavailable elsewhere		
			Information	q14b1_rcrev Rev: Information available from the MIS is not important	3	0.671

MIS success evalua-tion construct	PCA - components extracted #	Var.	Named	Items	# of items	Cron. Alpha
			importance	q14b4_rcrev Rev: Information from the MIS is never updated and current		
				q14b8_rcrev Rev: Information from the MIS is not easy to understand		
			Information accuracy	q14b2_rc The MIS contains all the key data that is needed	3	0.674
				q14b5_rc The MIS provides output that seems to be exactly what is needed		
				q14b3_rc Information available from the MIS is always accurate (does not often need correction)		
System quality	4	90.377	Speed, screen display	q14c11_rc The MIS requires only the minimum number of fields and screens to achieve a task	4	0.575
				q14c10_rc The MIS programme speed is quickly enough (responds quickly)		
				q14c7_rc The MIS always does what it should		
				q14c8_rc The MIS user interface (screen) can be easily adapted to one's personal approach (customise)		
			Ease of use	q14c1_rcrev Rev: The MIS is not easy to use	3	0.798
				q14c12_rc Modifications to the functionality of the MIS can easily be done (modified, corrected and improved)		
				q14c2_rc The MIS is easy to learn		
			Ease of access	q14c9_rc The MIS is always up-and-running as necessary (It has good connectivity, e.g. to network, server access, etc.)	3	0.753
				q14c6_rcrev Rev: The MIS does not include necessary features and functions		
				q14c3_rc It is not difficult to get access to information that is in the MIS		
			Information requiremen t	q14c5_rc The MIS meets (the TVET College's) information requirements	2	0.850
				q14c4_rc All data within the MIS is fully integrated and consistent		
Service quality	1	64.734	Service quality	q14c15_rc The MIS's service provider is experienced	5	0.841
				q14c17_rc The MIS's service provider provides quality services		
				q14c13_rc The MIS's service provider is reliable		
				q14c16_rc The MIS's service provider provides quality training		
				q14c14_rc The MIS's service provider has up-to-date facilities		
Organi-sational impact	1	80.609	Organisa-tional impact	q14d8_rc The MIS has resulted in cost reductions	8	0.927
				q14d7_rc The MIS has resulted in reduced staff costs		
				q14d2_rc The MIS has resulted in improved outcomes or outputs		
				q14d4_rc The MIS has resulted in improved business processes		
				q14d3_rc The MIS has resulted in an increased capacity to manage a growing volume of activity (e.g. transactions, population growth etc.)		
				q14d1_rc The MIS has resulted in overall productivity improvement		
				q14d5_rc The MIS has helped to improve communication and relationships		
				q14d6_rc The MIS is cost effective		
User satis-faction	4	86.207	Format	q14e10_rc How often is the system easy to use?	6	0.937
				q14e9_rc How often is the system user-friendly?		
				q14e7_rc How often do you think the output is presented in a useful format?		
				q14e4_rc How often is the system accurate?		
				q14e8_rc How often is the information clear?		
				q14e5_rc How often are you satisfied with the accuracy of the system?		
			Accuracy	q14e6_rcrev Rev: How often have you detected inconsistencies and inaccuracies in the content of the output reports from the system?	2	0.433
				q14e1_rc How often does the system provide the precise information you need?		
			Timeliness	q14e11_rc How often do you get the information you need in time?	2	0.727
				q14e12_rc How often does the system provide up-to-date		

MIS success evalua-tion construct	PCA - components extracted			Items	# of items	Cron. Alpha
	#	Var.	Named			
				information?		
			Content	q14e2_rc How often does the system provide reports that seem to be just about exactly what you need?	2	0.736
				q14e3_rc How often does the information content meet your needs?		
Overall evalua-tion	3	82.427	Satisfaction with data, outputs and the use of the system	q14f3_rc Overall, how satisfied are you with the quality of the data captured within the MIS?	5	0.904
				q14f1_rc Overall, how satisfied are you with the MIS in your working environment?		
				q14f4_rc Overall, how satisfied are you with the quality of the outputs from the MIS?		
				q14f2_rc Overall, how satisfied are you with using the MIS?		
				q14f10 All considered how would you rate your satisfaction with the MIS in your unit/department?		
			Satisfaction with the perform-ance and quality	q14f8a_rc Recode q14f8a to reflect range 1-5. Performance of unit/department.	4	0.870
				q14f8b_rc Recode q14f8b to reflect range 1-5. Quality of unit/departments work.		
				q14f9_rc Recode q14f9 to reflect range 1-5. MIS is worth the time and effort to use it.		
				q14f11 All considered how would you rate the success of the MIS in your unit/department?		
			Functioning obstacles	q14f5_rcrev Rev: How often are you prevented from or delayed in using the system due to computer errors, system crashes or other machine related problems?	3	0.930
				q14f7_rcrev Rev: How often are you prevented from or delayed in using the system because the system is working too slowly?		
				q14f6_rcrev Rev: How often are you prevented from or delayed in using the system due to password problems?		

Notes:

1. 'Var. Exp.' means variance explained by components extracted.

2. # means number.

3. 'Cron. Alpha' means Reliability Statistic (Cronbach's Alpha)

4. The postfix: '_rc' means the item was recoded (code 6 as missing) and the postfix: '_rcrev' means that the item was recoded and the negative statement was reversed to a positive statement.

The next section presents the procedures (based on the information presented in section 8.5.5.2) which were utilised to determine the MIS success evaluation constructs.

8.5.5.3. Creation and calculation of MIS success evaluation constructs

The MIS success evaluation constructs were calculated as follows:

- **Individual impact,** a second-order factor, was created by calculating the mean of five items that were used to create two first-order factors:

  - **Awareness,** a first-order factor, was created by calculating the mean of two items (q14a1_rc, q14a2_rc).
  - **Productivity,** a first-order factor, was created by calculating the mean of three items (q14a3_rc, q14a4_rc, q14a5_rc).
- **Information quality,** a second-order factor, was created by calculating the mean of the twelve items that were used to create three first-order factors:
  - **Information format,** a first-order factor, was created by calculating the mean of six items (q14b6_rc, q14b7_rc, q14b9_rc, q14b10_rc, q14b11_rc, q14b12_rc).
  - **Information importance,** a first-order factor, was created by calculating the mean of three items (q14b1_rcrev, q14b4_rcrev, q14b8_rcrev).
  - **Information accuracy**, a first-order factor, was created by calculating the mean of three items (q14b2_rc, q14b3_rc, q14b5_rc).
- **System quality,** a second-order factor, was created by calculating the mean of the twelve items that were used to create four first-order factors:
  - **Speed and screen display,** a first-order factor, was created by calculating the mean of four items (q14c7_rc, q14c8_rc, q14c10_rc, q14c11_rc).
  - **Ease of use,** a first-order factor, was created by calculating the mean of three items (q14c1_rcrev, q14c2_rc, q14c12_rc).
  - **Ease of access,** a first-order factor, was created by calculating the mean of three items (q14c3_rc, q14c6_rcrev, q14c9_rc).
  - **Information requirement,** a first-order factor, was created by calculating the mean of two items (q14c4_rc, q14c5_rc).
- **Service quality,** a first-order factor, was created by calculating the mean of five items (q14c13_rc, q14c14_rc, q14c15_rc, q14c16_rc, q14c17_rc);
- **Organisational impact,** a first-order factor, was created by calculating the mean of eight items (q14d1_rc, q14d2_rc, q14d3_rc, q14d4_rc, q14d5_rc, q14d6_rc, q14d7_rc, q14d8_rc).

- **User satisfaction,** a second-order factor, was created by calculating the mean of twelve items that were used to create four first-order factors:
    - **Format,** a first-order factor, was created by calculating the mean of seven items (q14e4_rc, q14e5_rc, q14e7_rc, q14e8_rc, q14e9_rc, q14e10_rc).
    - **Accuracy,** a first-order factor, was created by calculating the mean of two items (q14e1_rc, q14e6_rcrev).
    - **Timeliness,** a first-order factor, was created by calculating the mean of two items (q14e11_rc, q14e12_rc)
    - **Content,** a first-order factor, was created by calculating the mean of two items (q14e2_rc, q14e3_rc).

Two variables were created from the constructs, as described in the previous paragraph, to denote overall evaluation of the MIS, namely:

- Average of all items (54 questions: q14a1 up to q14e12) across the six MIS success constructs (named: *avgitems*);
- Average of the calculated values of the six MIS success constructs (named: *avgconstr*).

Another set of questions (q14f1 to 14f11) required of the participants to provide their overall perception of the quality, performance, satisfaction with, and success of the entire MIS. These items were included in the questionnaire as a verification measure to validate the responses to the MIS success constructs. Responses to these questions were compared to the variables: *avgitems* and *avgconstr*. The following variables were created from these questions:

- **Overall evaluation,** a second-order factor, was created by calculating the mean of twelve items that were used to create three first-order components:
    - **Component 1** (Satisfaction with data, outputs and the use of the system), a first-order factor, was created by calculating the mean of five items (q14f1_rc, q14f2_rc, q14f3_rc, q14f4_rc, q14f10).
    - **Component 2** (Satisfaction with the performance and quality), a first-order factor, was created by calculating the mean of four items (q14f8a_rc, q14f8b_rc, q14f9_rc, q14f11).

- o **Component 3** (Functioning obstacles), a first-order factor, was created by calculating the mean of three items (q14f5_rcrev, q14f6_rcrev, q14f7_rcrev).

Table 8.16 provides descriptive statistics for the MIS success evaluation constructs as described above.

Table 8.16. Descriptive statistics of the MIS success evaluation constructs for College 2.

MIS Success Evaluation construct	N	Minimum	Maximum	Mean		Std. Deviation	Variance
	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Statistic
Individual impact	13	3.400	5.000	4.32	0.149	0.539	0.290
Information quality	14	2.727	5.000	3.96	0.150	0.562	0.315
System quality	14	2.500	4.667	3.60	0.166	0.620	0.384
Service quality	13	2.000	5.000	3.60	0.254	0.917	0.841
Organisational impact	14	2.500	5.000	3.78	0.211	0.788	0.621
User satisfaction	14	2.917	5.000	3.98	0.154	0.576	0.332
Overall evaluation	14	2.980	4.926	3.86	0.136	0.510	0.261
Valid N (listwise)	13						

MIS users reported high scores for the impact of the system on their individual performance (Mean=4.32). The presence of the MIS enhanced their awareness and recall of job related information, and enhanced their productivity and effectiveness in their jobs most of the time. The construct that received the second highest average score was user satisfaction (Mean=3.98), which indicated that users valued the content and ease of use of the system, the accuracy, format and timeliness of the data. Based on the data, the quality of the system and the performance of the service provider needed further attention. These constructs received the lowest mean scores (Mean=3.6 in both cases) (cf. Table 8.16 and Figure 8.9).

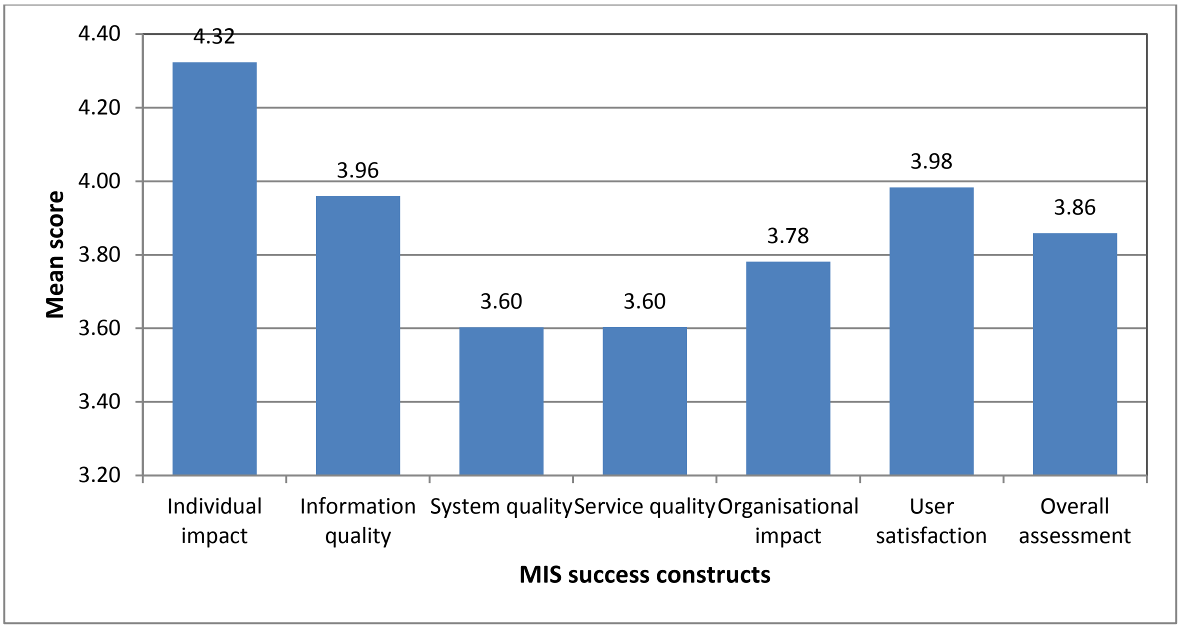


Figure 8.9. Mean scores for each MIS success construct for College 2.

The following section presents findings on an investigation into the relationships between the different measurements of the MIS success constructs.

8.5.5.4. Relationship between the MIS success constructs and the overall evaluation of the MIS

As presented in Table 8.17, bivariate correlation procedures were performed to investigate the relationships between MIS success constructs.

Kendall's tau-b (τb) correlation coefficient (Kendall, 1938) calculation procedures were utilised because it is a non-parametric measure of the strength and direction of association that exists between two variables measured on an ordinal or continuous scale (cf. Chapter 2, section 2.7.5). Pearson's product-moment correlation (Pearson, 1900) could not be used because the data is not normally distributed. Kendall's tau-b procedure was preferred to Spearman's rank-order correlation coefficient (Spearman, 1904) because the sample size (fourteen participants) was small with many tied ranks (Field, 2009, p. 175).

The following strong, statistically significant, positive correlations between MIS success constructs were observed:

- between *individual impact* and *information quality* (τb = .595, p = .006);
- between *individual impact* and *system quality* (τb = .443, p = .041);

- between *individual impact* and *overall evaluation* (τb = .470, p = .030);
- between *information quality* and *system quality* (τb = .456, p = .024);
- between *information quality* and *user satisfaction* (τb = .466, p = .023);
- between *information quality* and *overall evaluation* (τb = .611, p = .003);
- between *system quality* and *service quality* (τb = .623, p = .003);
- between *system quality* and *organisational impact* (τb = .456, p = .024);
- between *system quality* and *user satisfaction* (τb = .483, p = .018);
- between *system quality* and *overall evaluation* (τb = .802, p = .000);
- between *service quality* and *organisational impact* (τb = .458, p = .032);
- between *service quality* and *user satisfaction* (τb = .609, p = .005);
- between *service quality* and *overall evaluation* (τb = .623, p = .003);
- between *organisational impact* and *overall evaluation* (τb = .522, p = .010);
- between *user satisfaction* and *overall evaluation* (τb = .686, p = .001).

Table 8.17. Kendall's tau_b correlation matrix of MIS success constructs for College 2.

Kendall's tau_b		Individual impact	Information quality	System quality	Service quality	Organisational impact	User satisfaction	Overall evaluation
Individual impact	Correlation Coefficient	1.000						
	Sig. (2-tailed)							
	N	13						
Information quality	Correlation Coefficient	.595**	1.000					
	Sig. (2-tailed)	0.006						
	N	13	14					
System quality	Correlation Coefficient	.443*	.456*	1.000				
	Sig. (2-tailed)	0.041	0.024					
	N	13	14	14				
Service quality	Correlation Coefficient	0.313	0.353	.623**	1.000			
	Sig. (2-tailed)	0.153	0.098	0.003				
	N	13	13	13	13			
Organisational impact	Correlation Coefficient	0.068	0.393	.456*	.458*	1.000		
	Sig. (2-tailed)	0.756	0.054	0.024	0.032			
	N	13	14	14	13	14		
User satisfaction	Correlation Coefficient	0.343	.466*	.483*	.609**	0.295	1.000	
	Sig. (2-tailed)	0.119	0.023	0.018	0.005	0.151		
	N	13	14	14	13	14	14	
Overall evaluation	Correlation Coefficient	.470*	.611**	.802**	.623**	.522**	.686**	1.000
	Sig. (2-tailed)	0.030	0.003	0.000	0.003	0.010	0.001	
	N	13	14	14	13	14	14	14

*. Correlation is significant at the 0.05 level (2-tailed).
**. Correlation is significant at the 0.01 level (2-tailed).

These relationships can be summarised and graphically depicted in Figure 8.10.

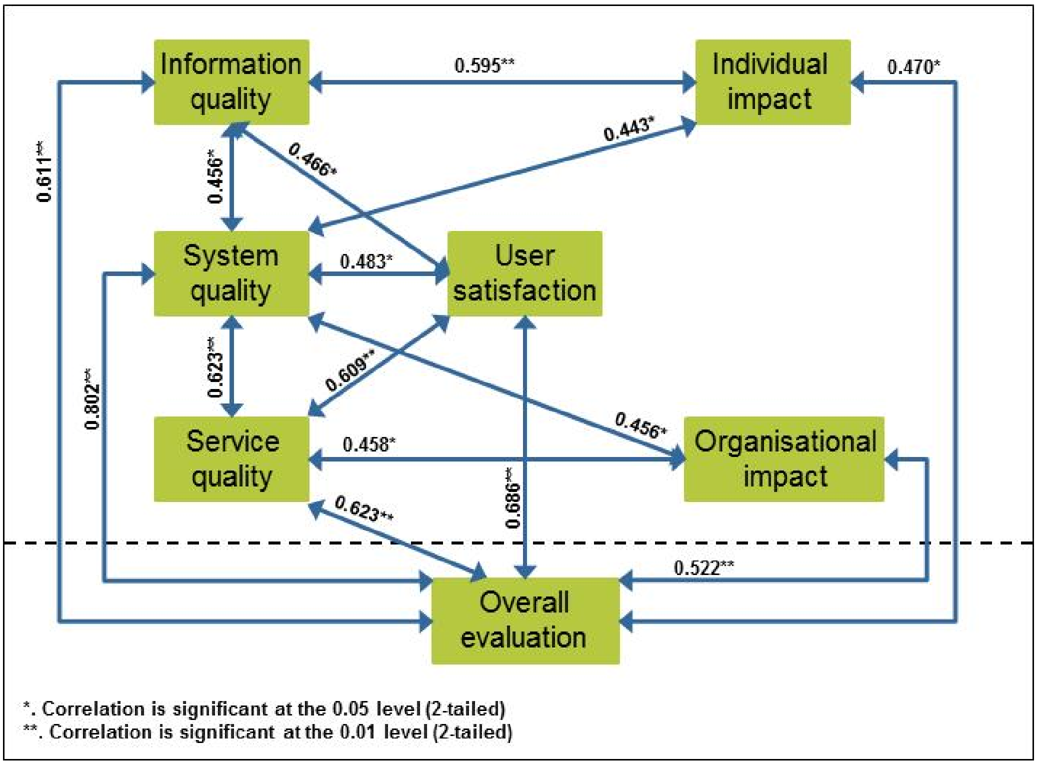


Figure 8.10. Statistically significant positive relationships between MIS success constructs for College 2.

- *Individual impact* significantly related to three constructs (information quality, system quality and overall evaluation);
- *Information quality* significantly related to four constructs (individual impact, system quality, user satisfaction and overall evaluation);
- *System quality* significantly related to six constructs (individual impact, information quality, service quality, user satisfaction, organisational impact and overall evaluation);
- *Service quality* significantly related to four constructs (system quality, organisational impact, user satisfaction and overall evaluation);
- *Organisational impact* significantly related to three constructs (system quality, service quality and overall evaluation);
- *User satisfaction* significantly related to four constructs (individual impact, system quality, service quality and overall evaluation).

8.5.5.5. Investigate predictor value with regression analysis

The predictor value of the MIS success construct variables to predict the dependent variable, *overall evaluation*, was investigated with regression analysis.

The dependent variable was firstly tested for normality, which is an assumption for linear regression analysis. A Shapiro-Wilk test (Shapiro & Wilk, 1965) was used to test for normality on the dependent variable, *overall evaluation* (cf. Chapter 2, section 2.7.6). The *overall evaluation* variable, $D(14) = 0.966$, $p > 0.05$, was not significant, indicating that the data was normally distributed.

All the MIS success construct variables were used in a multiple regression analysis, in which the Stepwise method was utilised (cf. Chapter 2, section 2.7.7) (Brace, Kemp & Snelgar, 2012). The analysis produced five models, as presented in Table 8.18.

In the first model we observe that *system quality* accounted for 78.6% of the total variance in the dependent variable *overall evaluation* ($R^2 = 0.804$, Adjusted $R^2 = 0.786$). The results in the ANOVA section show that in this model, *system quality* predicted *overall evaluation* of the MIS significantly well ($F = 45.183$, $p<0.05$). The model shows that for each unit increase in *system quality* an increase of 0.737 score points ($\beta = 0.737$, $p<0.05$) can be expected in the dependent variable (*overall evaluation*).

Of the five models, the independent variables in the fifth model explained most of the variance in the dependent variable – i.e. the variables *information quality*, *system quality*, *service quality*, *organisational impact* and *user satisfaction* explained 99.4% of the variance in the *overall evaluation* of the MIS ($R^2 = 0.997$, Adjusted $R^2 = 0.994$). The results in the ANOVA section show that in this model, these five independent variables predicted *overall evaluation* of the MIS significantly well ($F = 404.191$, $p<0.05$). The model furthermore shows that *information quality* contributed the most to the prediction of *overall evaluation* (standardised beta coefficient of $\beta = 0.304$). *System quality* (standardised beta coefficient of β = 0.262) contributed the second most and *user satisfaction* (standardised beta coefficient of β = 0.257) the third most.

Table 8.18. Results of a multiple regression analysis with *overall assessment* as the dependent variable and *the MIS success construct variables* as independent variables, College 2.

Model Summary				
Model	R	R Square	Adjusted R Square	Std. Error of the
1	.897[a]	0.804	0.786	0.24329557
2	.970[b]	0.941	0.929	0.14006883
3	.983[c]	0.967	0.956	0.11033694
4	.993[d]	0.986	0.978	0.07723243
5	.998[e]	0.997	0.994	0.04049571
a. Predictors: (Constant), system quality				
b. Predictors: (Constant), system quality, user satisfaction				
c. Predictors: (Constant), system quality, user satisfaction, information quality				
d. Predictors: (Constant), system quality, user satisfaction, information quality, organisational impact				
e. Predictors: (Constant), system quality, user satisfaction, information quality, organisational impact, service quality				

ANOVA[a]						
Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	2.675	1	2.675	45.183	.000[b]
	Residual	0.651	11	0.059		
	Total	3.326	12			
2	Regression	3.129	2	1.565	79.755	.000[c]
	Residual	0.196	10	0.020		
	Total	3.326	12			
3	Regression	3.216	3	1.072	88.057	.000[d]
	Residual	0.110	9	0.012		
	Total	3.326	12			
4	Regression	3.278	4	0.819	137.385	.000[e]
	Residual	0.048	8	0.006		
	Total	3.326	12			
5	Regression	3.314	5	0.663	404.191	.000[f]
	Residual	0.011	7	0.002		
	Total	3.326	12			
a. Dependent Variable: overall evaluation						
b. Predictors: (Constant), system quality						
c. Predictors: (Constant), system quality, user satisfaction						
d. Predictors: (Constant), system quality, user satisfaction, information quality						
e. Predictors: (Constant), system quality, user satisfaction, information quality, organisational impact						
f. Predictors: (Constant), system quality, user satisfaction, information quality, organisational impact, service quality						

Coefficients[a]						
Model		Unstandardised Coefficients		Standardised Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	1.168	0.403		2.897	0.015
	system quality	0.737	0.110	0.897	6.722	0.000
2	(Constant)	0.352	0.287		1.226	0.248
	system quality	0.526	0.077	0.640	6.847	0.000
	user satisfaction	0.399	0.083	0.450	4.815	0.001
3	(Constant)	0.093	0.246		0.376	0.715

Coefficients[a]						
Model		Unstandardised Coefficients		Standardised Coefficients	t	Sig.
		B	Std. Error	Beta		
	system quality	0.412	0.074	0.500	5.538	0.000
	user satisfaction	0.353	0.067	0.399	5.233	0.001
	information quality	0.218	0.082	0.238	2.667	0.026
4	(Constant)	0.029	0.174		0.165	0.873
	system quality	0.302	0.062	0.367	4.861	0.001
	user satisfaction	0.325	0.048	0.367	6.769	0.000
	information quality	0.230	0.057	0.251	4.015	0.004
	organisational impact	0.142	0.044	0.198	3.220	0.012
5	(Constant)	0.173	0.096		1.799	0.115
	system quality	0.215	0.037	0.262	5.739	0.001
	user satisfaction	0.228	0.033	0.257	6.990	0.000
	information quality	0.279	0.032	0.304	8.768	0.000
	organisational impact	0.129	0.023	0.180	5.542	0.001
	service quality	0.115	0.024	0.200	4.701	0.002
a. Dependent Variable: overall evaluation						

Excluded Variables[a]						
Model		Beta In	t	Sig.	Partial Correlation	Collinearity Statistics Tolerance
1	Individual impact	.095[b]	0.539	0.601	0.168	0.612
	Information quality	.356[b]	2.168	0.055	0.565	0.493
	Service quality	.387[b]	2.418	0.036	0.607	0.483
	Organisational impact	.267[b]	1.471	0.172	0.422	0.489
	User satisfaction	.450[b]	4.815	0.001	0.836	0.675
2	Individual impact	.056[c]	0.543	0.600	0.178	0.607
	Information quality	.238[c]	2.667	0.026	0.664	0.461
	Service quality	.107[c]	0.762	0.466	0.246	0.311
	Organisational impact	.182[c]	1.810	0.104	0.517	0.475
3	Individual impact	-.126[d]	-1.304	0.228	-0.419	0.364
	Service quality	.228[d]	2.484	0.038	0.660	0.277
	Organisational impact	.198[d]	3.220	0.012	0.751	0.473
4	Individual impact	.062[e]	0.607	0.563	0.224	0.187
	Service quality	.200[e]	4.701	0.002	0.871	0.273
5	Individual impact	.087[f]	2.006	0.092	0.634	0.185
a. Dependent Variable: overall evaluation						
b. Predictors in the Model: (Constant), system quality						
c. Predictors in the Model: (Constant), system quality, user satisfaction						
d. Predictors in the Model: (Constant), system quality, user satisfaction, information quality						
e. Predictors in the Model: (Constant), system quality, user satisfaction, information quality, organisational impact						
f. Predictors in the Model: (Constant), system quality, user satisfaction, information quality, organisational impact, service quality						

8.6. College 3: Findings transpired from the application of Phase C: Procedures and Phase D: Toolkit of the TVET-MIS-EVAL methodology

In College 3, the responsibility of 47 staff members was to capture and maintain the information on the system related to student administration, academic administration, financial administration, human resource management and development, asset management, and technical administration and maintenance of the system. All MIS users participated in the survey questionnaire – 100% response rate was achieved (cf. Appendix E). A semi-structured interview was conducted with two management staff members (the Deputy Principal Academic Affairs and a MIS specialist) at the college (cf. Appendix D).

8.6.1. Qualitative data and information

Very rich qualitative information was gathered through the interview and it was clear that the two interviewees were specialists in their respective areas. The interview was recorded with a digital recorder and covered more subject matter than was proposed in the semi-structured interview schedule (cf. Appendix D). Topics such as the Competency Assessment Placement Test (CAPT) that students take before registration at the college, and the fact that the college was one of a few colleges that were participating in a pilot in which students could register online for funding from the National Student Financial Aid Scheme (NSFAS) before registration at the college, were also discussed (Interviewee 2, 2015; Interviewee 3, 2015).

It became apparent during the interview (cf. Table 2.6) that College 3 was considering migrating to another system, not because they were unhappy with the system utilised at the time of the interview, but because management perceived the fact that the system had been developed and was being maintained by only one person, a lecturer at another public TVET College, who is approaching retirement age, posed a risk to the college (Interviewee 2, 2015; Interviewee 3, 2015). Both interviewees agreed that the system is extremely beneficial to the college in terms of its functionality, efficiency and effectiveness, and furthermore remarkably cheaper than any other system utilised in the public TVET College sector. According to the interviewees, the system is comprehensive and includes more functionality than what the college has been using it for. For example, the aspect of the system which assists with student placement had not been used yet.

There was no restriction laid upon staff as to who may access the system. Once the request has been approved, access rights to the system were allocated.

The college was satisfied with the support received from the MIS service provider. Quick turnover times for queries and assistance was achieved and the service provider even accessed the system remotely from his office to address system issues, when necessary. The service provider was responsive to changes in the data requirements of the DHET and provided frequent and timeous updates to the system.

Additional qualitative findings will be integrated where applicable in the quantitative findings presented in the following sections. The next section presents information on the demographic profile of the MIS users at College 3.

8.6.2. Demographics of MIS users

Data analysis of the survey administered to users of the MIS at College 3 revealed the following results:

- Almost two-thirds (65%) of the MIS users were female and 35% were male;
- More than half (56%) of the MIS users were younger than 35 years of age, whilst 41% were 40 years or older;
- The highest level of education of 21% of the MIS users was a degree or more advanced. The rest of the respondents had a diploma or advanced certificate (52%), or a higher certificate (15%) or a matric certificate (12%);
- 11% of the users were management, 4% lecturing and 85% support staff;
- 83% were full-time and 17% part-time employees;

- The majority of the users were end-users (67%) – the rest key-users;
- 72% of the users were permanent and 28% fixed-term employees;
- 26% of all users had less than five years of working experience in total and 47% had less than five years working experience at the college;
- 31% had ten or more years of working experience at the college;
- 61% of the users received training on the MIS, of which, 67% received in-house training, 7% received training externally and 26% received in-house as well as training from the external service provider.

8.6.3. Computer proficiency of users

A series of questions (questions 11a to 11e) in the survey questionnaire investigated the level of computer proficiency of MIS users. A Principal Component Analysis (PCA) of these items produced two components, depicted in Tables 8.19 and 8.20. The two components explained 80.7% of the total variance in the sample (Table 8.19).

A variable for computer proficiency was generated by using the responses to these questions as follows: firstly, the averages of the extracted components were calculated (i.e. average for questions q11b, q11c, q11d and 11e called *CompSkills*); and secondly, the average of the *CompSkills* and question 11a was calculated. The final variable was called *CompProf* (computer proficiency).

Table 8.19. Principal Component Analysis (PCA): Total variance explained.

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	3.024	60.484	60.484	3.024	60.484	60.484	3.012	60.240	60.240
2	1.011	20.224	80.708	1.011	20.224	80.708	1.023	20.468	80.708
3	0.507	10.133	90.841						
4	0.383	7.651	98.492						
5	0.075	1.508	100.000						

Extraction Method: Principal Component Analysis.

Table 8.20. Principal Component Analysis: Extracted components.

Items	Component	
	1	2
q11b_comp Competency in computer skills?	0.937	
q11c_word Competency in MS Word?	0.930	
q11d_excel Competency in MS Excel?	0.822	
q11e_email Competency in email software?	0.768	
q11a_tech Competency in technical skills?		0.996

Extraction Method: Principal Component Analysis. Rotation Method: Varimax with Kaiser Normalisation.
a. Rotation converged in 4 iterations.

The majority of the users (65% or thirty users) had above average levels of computer proficiency, whilst 17% (eight users) rated themselves as having excellent computer proficiency skills (Figure 8.11).

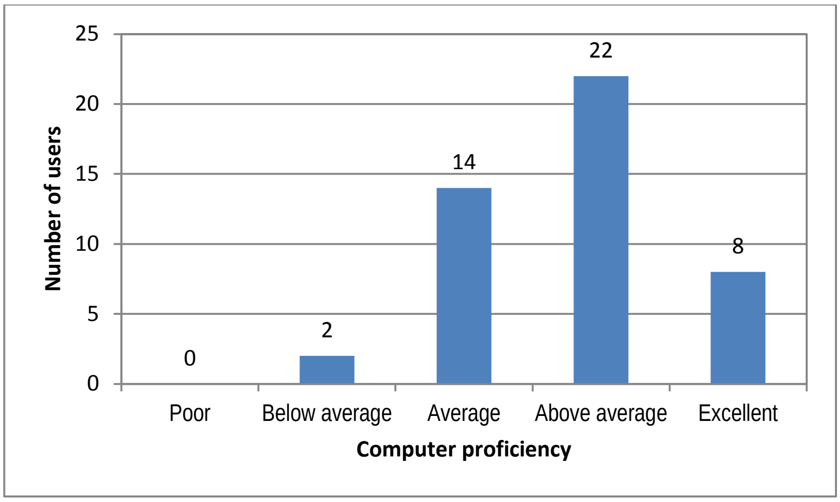


Figure 8.11. Number of users by level of computer proficiency, College 3.

The following section presents information about the users' involvement with the MIS.

8.6.4. Extent of use of the MIS

In College 3, all ranks of staff were represented as part of the team responsible for certain activities within the MIS. Five management, two lecturing and thirty-nine support staff were working on the system on a daily basis. One management and one support staff member were involved in all six components of the system, as presented in Table 8.21.

Table 8.21. Position of staff by number of components used daily, College 3.

Position of staff	One component	Two components	Three components	Four components	Six components	Total
Management staff	1	3	0	0	1	5
Lecturing staff	1	1	0	0	0	2
Support staff	14	14	8	2	1	39
Total	16	18	8	2	2	46

Most of the users were involved in student administration (39) and academic administration (26) activities. Seven users were responsible for the technical administration and maintenance of the MIS as depicted in Figure 8.12.

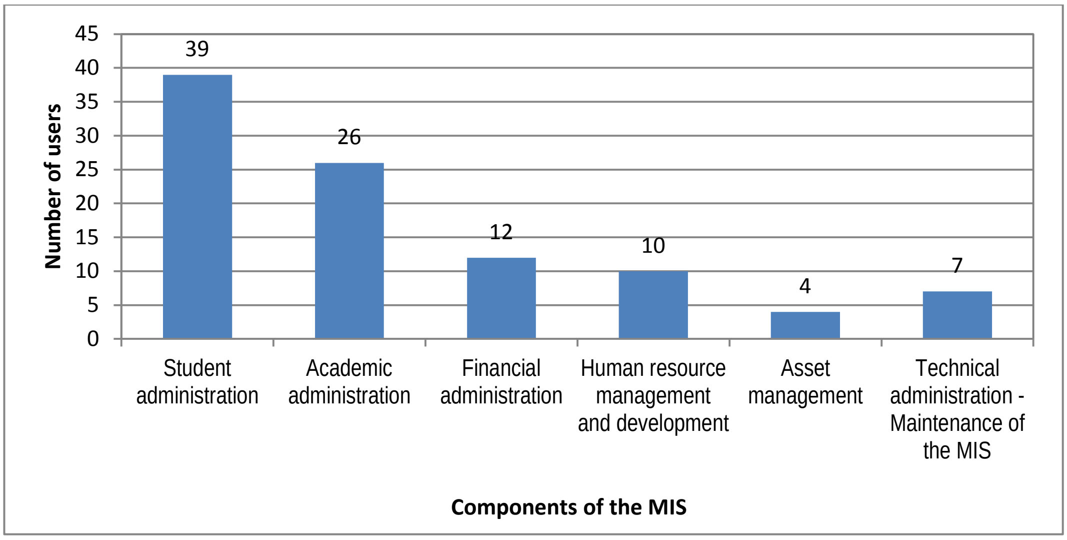


Figure 8.12. Number of users by MIS component, College 3.

Two users had access and used all the components of the MIS, while 31 participants used at the most two components of the system as depicted in Figure 8.13.

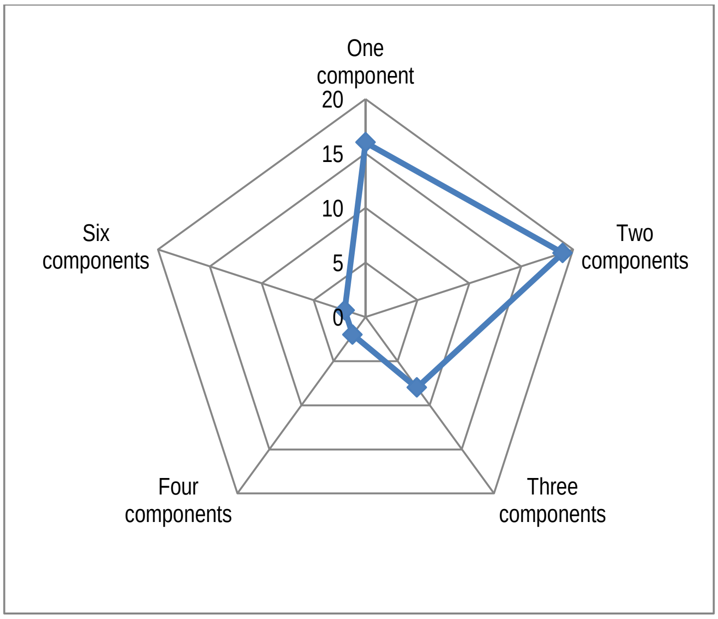


Figure 8.13. Number of users by access to number of components, College 3.

Sections 8.6.1, 8.6.2 and 8.6.3 reported on the profile of the MIS users for the purpose of understanding the user context of the setting in which the MIS is utilised. The following section will focus on the evaluation of the MIS itself.

8.6.5. Evaluation of MIS

The items contained within the instruments concerning the evaluation of the MIS were discussed in detail in the introduction of section 8.4.5. To avoid duplication, please refer to section 8.4.5 for background information regarding the MIS success constructs and their underlying items. The following section provides statistics with regard to individual MIS success evaluation items, which underlie the MIS success constructs.

8.6.5.1. Statistical significance and Weighted Average Index (WAI)

The confidence interval for each item in the questionnaire related to the success evaluation constructs (i.e. Information quality, Systems quality, Service quality, User Satisfaction, Individual impact and Organisational impact) of the MIS was calculated and showed that all variables were statistically significant at the 95% confidence level, with t-values above 1.96 and p-values below 0.05, as presented in Table 8.22.

Weighted average indices and means were calculated for each item and presented in Table 8.22. The means varied from a maximum of 4.10 to a minimum of 2.79.

The top four items with the highest WAI values and means were related to *individual impact*. The MIS users reported that their awareness (Mean=4.10) and recall (Mean=3.93) of job related information were enhanced, their productivity increased (Mean=4.05), they have learnt much through the presence of the MIS (Mean=4.03), and the MIS enhanced their effectiveness in their jobs (Mean=4.00). The users furthermore appreciated the easiness with which they learnt the system: *The MIS is easy to learn* (Mean=3.91) and *How often is the system easy to use?* (Mean=3.93).

Items that received the lowest rates were related to *systems quality* and *information quality*. The following items: *The output reports from the system are consistent and accurate* (Mean=2.79), *Information available from the MIS is always accurate (does not often need correction)* (Mean=3.13), *Information from the MIS is always updated and current* (Mean=3.13), *The MIS's service provider is reliable* (Mean=3.39), *The MIS programme speed is quick enough (responds quickly)* (Mean=3.39), bear evidence to that.

More than half of the scores (58%) was a four or above, which indicates that the system performed well most of the time for more than half of the items. Scores of three and lower (for 52% of the items) could be considered as a below average performance (Figure 8.14).

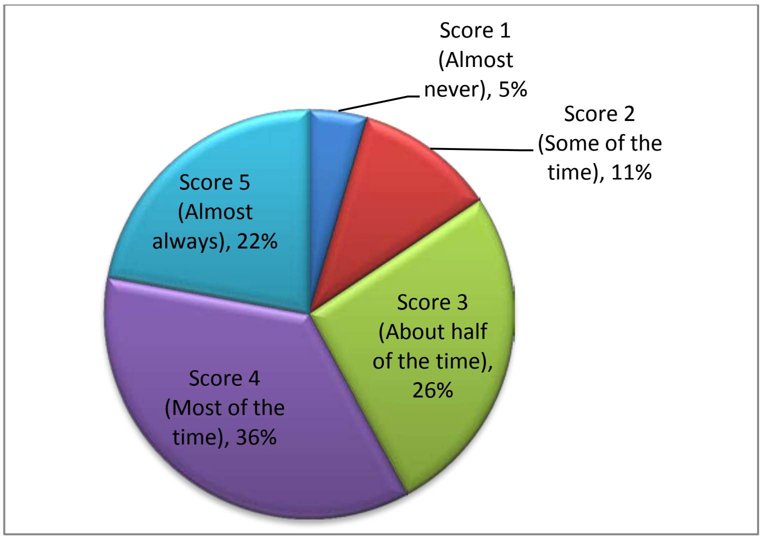


Figure 8.14. Distribution of participants' scores across all MIS evaluation items for College 3.

Table 8.22. Statistics with regard to the items/variables used in the success evaluation of the MIS at College 3.

MIS success evaluation constructs and underlying items (variables)	Mean	Std. Deviation	Std. Error Mean	t (Test Value = 0)	df	Sig. (2-tailed)	95% Confidence Interval of the Mean			Frequency of score					
							Lower	Upper	N	1	2	3	4	5	WAI
Individual impact															
q14a1_rc I have learnt much through the presence of the MIS	4.03	0.974	0.154	26.144	39	0.000	3.71	4.34	40	1	3	3	20	13	4.03
q14a2_rc The MIS enhances my awareness of job related information	4.10	0.906	0.140	29.309	41	0.000	3.81	4.38	42	1	1	6	19	15	4.10
q14a3_rc The MIS enhances my recall of job related information	3.93	0.921	0.142	27.641	41	0.000	3.64	4.22	42	1	2	7	21	11	3.93
q14a4_rc The MIS enhances my effectiveness in the job	4.00	0.949	0.148	26.998	40	0.000	3.70	4.30	41		4	6	17	14	4.00
q14a5_rc The MIS increases my productivity	4.05	0.932	0.147	27.474	39	0.000	3.75	4.35	40		3	7	15	15	4.05
Information quality															
q14b1_rcrev Rev: Information available from the MIS is not important	3.90	1.483	0.237	16.411	38	0.000	3.42	4.38	39	5	3	5	4	22	3.90
q14b2_rc The MIS contains all the key data that is needed	3.80	1.160	0.173	21.976	44	0.000	3.45	4.15	45		10	5	14	16	3.80
q14b3_rc Information available from the MIS is always accurate (does not often need correction)	3.13	1.254	0.187	16.760	44	0.000	2.76	3.51	45	4	13	8	13	7	3.13
q14b4_rcrev Rev: Information from the MIS is never updated and current	3.13	1.218	0.195	16.041	38	0.000	2.73	3.52	39	2	13	9	8	7	3.13
q14b5_rc The MIS provides output that seems to be exactly what is needed	3.74	1.021	0.150	24.849	45	0.000	3.44	4.04	46	1	5	10	19	11	3.74
q14b6_rc Information needed from the MIS is always available	3.56	1.140	0.174	20.463	42	0.000	3.21	3.91	43	2	6	11	14	10	3.56
q14b7_rc Information from the MIS is in a format that is readily usable	3.58	1.220	0.186	19.257	42	0.000	3.21	3.96	43	3	6	8	15	11	3.58
q14b8_rcrev Rev: Information from the MIS is not easy to understand	3.80	1.147	0.169	22.489	45	0.000	3.46	4.15	46	2	5	8	16	15	3.80
q14b9_rc Information from the MIS appears readable, clear and well formatted	3.90	0.955	0.151	25.817	39	0.000	3.59	4.21	40		4	8	16	12	3.90
q14b10_rc Information from the MIS is concise	3.77	0.886	0.134	28.257	43	0.000	3.50	4.04	44	1	2	11	22	8	3.77
q14b11_rc Information from the MIS is always timely	3.43	1.021	0.154	22.303	43	0.000	3.12	3.74	44	1	7	15	14	7	3.43
q14b12_rc Information from the MIS is unavailable elsewhere	3.03	1.424	0.237	12.757	35	0.000	2.55	3.51	36	8	4	10	7	7	3.03
System quality															
q14c1_rcrev Rev: The MIS is not easy to use	3.63	1.215	0.185	19.573	42	0.000	3.25	4.00	43	1	9	9	10	14	3.63
q14c2_rc The MIS is easy to learn	3.91	0.947	0.144	27.067	42	0.000	3.62	4.20	43	1	3	6	22	11	3.91
q14c3_rc It is not difficult to get access to information that is in the MIS	3.65	1.110	0.169	21.566	42	0.000	3.31	3.99	43	1	7	9	15	11	3.65
q14c4_rc All data within the MIS is fully integrated and consistent	3.51	0.935	0.143	24.619	42	0.000	3.22	3.80	43		6	16	14	7	3.51
q14c5_rc The MIS meets (the TVET College's) information requirements	3.54	1.027	0.160	22.048	40	0.000	3.21	3.86	41	1	5	14	13	8	3.54

MIS success evaluation constructs and underlying items (variables)	Mean	Std. Deviation	Std. Error Mean	t (Test Value = 0)	df	Sig. (2-tailed)	95% Confidence Interval of the Mean			Frequency of score					
							Lower	Upper	N	1	2	3	4	5	WAI
q14c6_rcrev Rev: The MIS does not include necessary features and functions	3.45	1.154	0.182	18.915	39	0.000	3.08	3.82	40	1	9	10	11	9	3.45
q14c7_rc The MIS always does what it should	3.63	1.040	0.153	23.665	45	0.000	3.32	3.94	46	1	6	12	17	10	3.63
q14c8_rc The MIS user interface (screen) can be easily adapted to one's personal approach (customise)	3.03	1.498	0.243	12.458	37	0.000	2.53	3.52	38	10	4	6	11	7	3.03
q14c9_rc The MIS is always up-and-running as necessary (It has good connectivity, e.g. to network, server access, etc.)	3.53	1.036	0.154	22.885	44	0.000	3.22	3.84	45	2	5	12	19	7	3.53
q14c10_rc The MIS programme speed is quick enough (responds quickly)	3.39	1.039	0.157	21.617	43	0.000	3.07	3.70	44	3	3	18	14	6	3.39
q14c11_rc The MIS requires only the minimum number of fields and screens to achieve a task	3.62	0.936	0.140	25.950	44	0.000	3.34	3.90	45	1	4	13	20	7	3.62
q14c12_rc Modifications to the functionality of the MIS can easily be done (modified, corrected and improved)	3.59	1.117	0.179	20.065	38	0.000	3.23	3.95	39	1	7	8	14	9	3.59
Service quality															
q14c13_rc The MIS's service provider is reliable	3.39	0.972	0.152	22.344	40	0.000	3.08	3.70	41	1	6	15	14	5	3.39
q14c14_rc The MIS's service provider has up-to-date facilities	3.44	1.161	0.177	19.441	42	0.000	3.08	3.80	43	3	5	14	12	9	3.44
q14c15_rc The MIS's service provider is experienced	3.55	1.032	0.167	21.224	37	0.000	3.21	3.89	38	1	4	14	11	8	3.55
q14c16_rc The MIS's service provider provides quality training	3.31	1.217	0.195	16.969	38	0.000	2.91	3.70	39	4	5	12	11	7	3.31
q14c17_rc The MIS's service provider provides quality services	3.43	0.984	0.156	22.010	39	0.000	3.11	3.74	40	1	5	16	12	6	3.43
Organisational impact															
q14d1_rc The MIS has resulted in overall productivity improvement	3.49	1.032	0.157	22.162	42	0.000	3.17	3.81	43	2	4	15	15	7	3.49
q14d2_rc The MIS has resulted in improved outcomes or outputs	3.62	0.987	0.152	23.774	41	0.000	3.31	3.93	42	1	4	13	16	8	3.62
q14d3_rc The MIS has resulted in an increased capacity to manage a growing volume of activity (e.g. transactions, population growth etc.)	3.58	0.874	0.138	25.877	39	0.000	3.30	3.85	40		4	15	15	6	3.58
q14d4_rc The MIS has resulted in improved business processes	3.71	0.944	0.146	25.487	41	0.000	3.42	4.01	42		3	17	11	11	3.71
q14d5_rc The MIS has helped to improve communication and relationships	3.50	1.059	0.172	20.372	37	0.000	3.15	3.85	38	2	3	14	12	7	3.50
q14d6_rc The MIS is cost effective	3.50	1.059	0.172	20.372	37	0.000	3.15	3.85	38	2	2	17	9	8	3.50
q14d7_rc The MIS has resulted in reduced staff costs	3.35	1.111	0.183	18.349	36	0.000	2.98	3.72	37	3	3	15	10	6	3.35
q14d8_rc The MIS has resulted in cost reductions	3.35	0.917	0.157	21.315	33	0.000	3.03	3.67	34	1	4	14	12	3	3.35
User satisfaction															
q14e1_rc How often does the system provide the precise information you need?	3.86	1.014	0.155	24.971	42	0.000	3.55	4.17	43	2	2	7	21	11	3.86

MIS success evaluation constructs and underlying items (variables)	Mean	Std. Deviation	Std. Error Mean	t (Test Value = 0)	df	Sig. (2-tailed)	95% Confidence Interval of the Mean			Frequency of score					
							Lower	Upper	N	1	2	3	4	5	WAI
q14e2_rc How often does the system provide reports that seem to be just about exactly what you need?	3.86	1.002	0.155	24.954	41	0.000	3.54	4.17	42	1	3	9	17	12	3.86
q14e3_rc How often does the information content meet your needs?	3.72	1.031	0.157	23.664	42	0.000	3.40	4.04	43	1	5	9	18	10	3.72
q14e4_rc How often is the system accurate?	3.64	0.967	0.146	24.952	43	0.000	3.34	3.93	44	2	2	13	20	7	3.64
q14e5_rc How often are you satisfied with the accuracy of the system?	3.69	0.996	0.148	24.846	44	0.000	3.39	3.99	45	2	2	13	19	9	3.69
q14e6_rcrev Rev: How often have you detected inconsistencies and inaccuracies in the content of the output reports from the system?	2.79	1.125	0.171	16.273	42	0.000	2.44	3.14	43	6	11	15	8	3	2.79
q14e7_rc How often do you think the output is presented in a useful format?	3.64	0.967	0.146	24.952	43	0.000	3.34	3.93	44	1	2	19	12	10	3.64
q14e8_rc How often is the information clear?	3.83	0.902	0.133	28.771	45	0.000	3.56	4.09	46		3	14	17	12	3.83
q14e9_rc How often is the system user-friendly?	3.80	1.002	0.151	25.130	43	0.000	3.49	4.10	44		5	12	14	13	3.80
q14e10_rc How often is the system easy to use?	3.93	0.884	0.135	29.168	42	0.000	3.66	4.20	43		2	12	16	13	3.93
q14e11_rc How often do you get the information you need in time?	3.74	0.912	0.141	26.556	41	0.000	3.45	4.02	42	1	2	12	19	8	3.74
q14e12_rc How often does the system provide up-to-date information?	3.64	0.958	0.148	24.639	41	0.000	3.34	3.94	42	1	4	11	19	7	3.64
Overall assessment															
q14f1_rc Overall, how satisfied are you with the MIS in your working environment?	3.76	1.119	0.165	22.790	45	0.000	3.43	4.09	46	3	3	8	20	12	3.76
q14f2_rc Overall, how satisfied are you with using the MIS?	3.73	1.195	0.178	20.963	44	0.000	3.37	4.09	45	3	5	6	18	13	3.73
q14f3_rc Overall, how satisfied are you with the quality of the data captured within the MIS?	3.61	1.061	0.160	22.586	43	0.000	3.29	3.94	44	3	1	15	16	9	3.61
q14f4_rc Overall, how satisfied are you with the quality of the outputs from the MIS?	3.82	0.984	0.147	26.065	44	0.000	3.53	4.12	45	2	1	11	20	11	3.82
q14f5_rcrev Rev: How often are you prevented from or delayed in using the system due to computer errors, system crashes or other machine related problems?	2.91	1.164	0.174	16.773	44	0.000	2.56	3.26	45	4	15	12	9	5	2.91
q14f6_rcrev Rev: How often are you prevented from or delayed in using the system due to password problems?	3.17	1.480	0.218	14.542	45	0.000	2.73	3.61	46	9	7	9	9	12	3.17
q14f7_rcrev Rev: How often are you prevented from or delayed in using the system because the system is working too slowly?	3.04	1.348	0.201	15.154	44	0.000	2.64	3.45	45	7	9	13	7	9	3.04
q14f8a_rc The performance of our unit/department has become:	3.67	0.896	0.134	27.459	44	0.000	3.40	3.94	45	1	3	11	24	6	3.69
q14f8b_rc The quality of our unit's/department's work has become:	3.54	0.877	0.129	27.364	45	0.000	3.28	3.80	46	1	5	11	26	3	3.54
q14f9_rc The MIS is worth the time and effort to use it:	3.77	1.050	0.155	24.362	45	0.000	3.46	4.09	46	2	1	14	18	11	3.76

MIS success evaluation constructs and underlying items (variables)	Mean	Std. Deviation	Std. Error Mean	t (Test Value = 0)	df	Sig. (2-tailed)	95% Confidence Interval of the Mean			Frequency of score					
							Lower	Upper	N	1	2	3	4	5	WAI
q14f10 All considered how would you rate your satisfaction with the MIS in your unit/department?	3.78	0.786	0.116	32.625	45	0.000	3.55	4.02	46		2	14	22	8	3.78
q14f11 All considered how would you rate the success of the MIS in your unit/department?	3.76	0.848	0.125	30.075	45	0.000	3.51	4.01	46		4	11	23	8	3.76

Notes:

Df: Degrees of freedom; Sig: Statistically significant; WAI: Weighted Average Index

8.6.5.2. Preparation of data for the calculation of the MIS success evaluation constructs

For each MIS success evaluation construct, as listed in Table 8.23, the underlying items or variables were tested for unidimensionality (Principal Component Analysis [PCA]) (cf. section 2.7.3) (Pearson, 1901) and internal consistency (Cronbach’s alpha scale reliability testing) (cf. section 2.7.4) (Cronbach, 1951). First-order underlying constructs were created and named, from the components that emerged from the tests for unidimensionality, and presented in Table 8.23. The variance explained by each set of components (calculated by using PCA) and the Reliability Statistic (Cronbach’s Alpha) for each set of items that comprised a component is provided in Table 8.23. In all PCAs more than 68% of the variance was explained by the extracted components. The strength of the internal reliability of items within each extracted component was high in all instances, except for *usability* (Cronbach Alpha, α=0.210) and *content and information* (Cronbach Alpha, α=0.271). Elaborative notes on the extracted components are presented in section 8.6.4.3.

Statistical analyses were performed by using IBM SPSS Statistics version 24 (SPSS an IBM Company, 2017) and the results were recorded in MS Excel 2010 (Microsoft, 2010). The IBM SPSS syntax file and the MS Excel file in which all these analyses were recorded are available on the compact disk provided with the thesis.

Table 8.23. Components extracted with PCA and reliability statistic of each MIS success evaluation construct, College 3.

MIS success evaluation construct	PCA - components extracted			Items	# of items	Cron. Alpha
	#	Var.	Named			
Individual impact	1	80.019	Individual impact	q14a5_rc The MIS increases my productivity	5	0.937
				q14a3_rc The MIS enhances my recall of job related information		
				q14a4_rc The MIS enhances my effectiveness in the job		
				q14a1_rc I have learnt much through the presence of the MIS		
				q14a2_rc The MIS enhances my awareness of job related information		
Information quality	3	76.800	Data quality	q14b6_rc Information needed from the MIS is always available	8	0.925
				q14b9_rc Information from the MIS appears readable, clear and well formatted		
				q14b11_rc Information from the MIS is always timely		
				q14b2_rc The MIS contains all the key data that is needed		

MIS success evaluation construct	PCA - components extracted			Items	# of items	Cron. Alpha
	#	Var.	Named			
				q14b10_rc Information from the MIS is concise		
				q14b5_rc The MIS provides output that seems to be exactly what is needed		
				q14b7_rc Information from the MIS is in a format that is readily usable		
				q14b3_rc Information available from the MIS is always accurate (does not often need correction)		
			Data avail-ability	q14b8_rcrev Rev: Information from the MIS is not easy to understand	2	0.558
				q14b12_rc Information from the MIS is unavailable elsewhere		
			Data importance	q14b4_rcrev Rev: Information from the MIS is never updated and current	2	0.605
				q14b1_rcrev Rev: Information available from the MIS is not important		
System quality	3	68.748	Function-ality	q14c9_rc The MIS is always up-and-running as necessary (It has good connectivity, e.g. to network, server access, etc.)	4	0.828
				q14c10_rc The MIS programme speed is quick enough (responds quickly)		
				q14c11_rc The MIS requires only the minimum number of fields and screens to achieve a task		
				q14c12_rc Modifications to the functionality of the MIS can easily be done (modified, corrected and improved)		
			Data access and quality	q14c5_rc The MIS meets (the TVET College's) information requirements	5	0.821
				q14c4_rc All data within the MIS is fully integrated and consistent		
				q14c7_rc The MIS always does what it should		
				q14c8_rc The MIS user interface (screen) can be easily adapted to one's personal approach (customise)		
				q14c3_rc It is not difficult to get access to information that is in the MIS		
			Usability	q14c6_rcrev Rev: The MIS does not include necessary features and functions	3	0.210
				q14c2_rc The MIS is easy to learn		
				q14c1_rcrev Rev: The MIS is not easy to use		
Service quality	1	82.835	Service quality	q14c14_rc The MIS's service provider has up-to-date facilities	5	0.945
				q14c17_rc The MIS's service provider provides quality services		
				q14c13_rc The MIS's service provider is reliable		
				q14c16_rc The MIS's service provider provides quality training		
				q14c15_rc The MIS's service provider is experienced		
Organisational impact	1	82.539	Organisa-tional impact	q14d7_rc The MIS has resulted in reduced staff costs	8	0.969
				q14d8_rc The MIS has resulted in cost reductions		
				q14d5_rc The MIS has helped to improve communication and relationships		
				q14d6_rc The MIS is cost effective		
				q14d2_rc The MIS has resulted in improved outcomes or outputs		
				q14d1_rc The MIS has resulted in overall productivity improvement		
				q14d4_rc The MIS has resulted in improved business processes		
				q14d3_rc The MIS has resulted in an increased capacity to manage a growing volume of activity (e.g. transactions, population growth etc.)		
User satisfaction	2	79.686	Accuracy, ease of use and timeliness	q14e12_rc How often does the system provide up-to-date information?	8	0.953
				q14e11_rc How often do you get the information you need in time?		
				q14e10_rc How often is the system easy to use?		
				q14e9_rc How often is the system user-friendly?		
				q14e1_rc How often does the system provide the precise information you need?		
				q14e8_rc How often is the information clear?		
				q14e4_rc How often is the system accurate?		

MIS success evaluation construct	PCA - components extracted #	Var.	Named	Items	# of items	Cron. Alpha
				q14e5_rc How often are you satisfied with the accuracy of the system?		
			Content and format	q14e6_rcrev Rev: How often have you detected inconsistencies and inaccuracies in the content of the output reports from the system?	4	0.271
				q14e7_rc How often do you think the output is presented in a useful format?		
				q14e3_rc How often does the information content meet your needs?		
				q14e2_rc How often does the system provide reports that seem to be just about exactly what you need?		
Overall evaluation	3	79.593	Satisfaction with data, outputs and the use of the system	q14f2_rc Overall, how satisfied are you with using the MIS?	6	0.941
				q14f1_rc Overall, how satisfied are you with the MIS in your working environment?		
				q14f4_rc Overall, how satisfied are you with the quality of the outputs from the MIS?		
				q14f3_rc Overall, how satisfied are you with the quality of the data captured within the MIS?		
				q14f11 All considered how would you rate the success of the MIS in your unit/department?		
				q14f10 All considered how would you rate your satisfaction with the MIS in your unit/department?		
			Functioning obstacles	q14f7_rcrev Rev: How often are you prevented from or delayed in using the system because the system is working too slowly?	3	0.855
				q14f5_rcrev Rev: How often are you prevented from or delayed in using the system due to computer errors, system crashes or other machine related problems?		
				q14f6_rcrev Rev: How often are you prevented from or delayed in using the system due to password problems?		
			Performance and quality of work related to system	q14f8b_rc All considered to what extent has the MIS changed the following two aspects of your own unit or department? Quality has become:	3	0.745
				q14f9_rc How much do you agree with the following statement? The MIS is worth the time and effort to use it:		
				q14f8a_rc All considered to what extent has the MIS changed the following two aspects of your own unit or department? Performance has become:		

Notes:

1. 'Var. Exp.' means variance explained by components extracted.

2. # means number.

3. 'Cron. Alpha' means Reliability Statistic (Cronbach's Alpha)

4. The postfix: '_rc' means the item was recoded (code 6 as missing) and the postfix: '_rcrev' means that the item was recoded and the negative statement was reversed to a positive statement

The next section presents the procedures (based on the information presented in section 8.6.5.2) which were utilised to determine the MIS success evaluation constructs.

8.6.5.3. Creation and calculation of MIS success evaluation constructs

The MIS success evaluation constructs were calculated as follows:

- **Individual impact,** a first-order factor, was created by calculating the mean of five items (q14a1_rc, q14a2_rc, q14a3_rc, q14a4_rc, q14a5_rc);
- **Information quality,** a second-order factor, was created by calculating the mean of the twelve items that were used to create three first-order factors:
  - **Data quality,** a first-order factor, was created by calculating the mean of eight items (q14b2_rc, q14b3_rc, q14b5_rc q14b6_rc, q14b7_rc, q14b9_rc, q14b10_rc, q14b11_rc).
  - **Data availability,** a first-order factor, was created by calculating the mean of two items (q14b8_rcrev, q14b12_rc)
  - **Data importance,** a first-order factor, was created by calculating the mean of two items (q14b1_rcrev, q14b4_rcrev).
- **System quality,** a second-order factor, was created by calculating the mean of the twelve items that were used to create three first-order factors:
  - **Functionality,** a first-order factor, was created by calculating the mean of four items (q14c9_rc, q14c10_rc, q14c11_rc, q14c12_rc).
  - **Data access and quality,** a first-order factor, was created by calculating the mean of five items (q14c3_rc, q14c4_rc, q14c5_rc, q14c7_rc, q14c8_rc)
  - **Usability,** a first-order factor, was created by calculating the mean of three items (q14c1_rcrev, q14c2_rc, q14c6_rcrev).
- **Service quality,** a first-order factor, was created by calculating the mean of five items (q14c13_rc, q14c14_rc, q14c15_rc, q14c16_rc, q14c17_rc);
- **Organisational impact,** a first-order factor, was created by calculating the mean of eight items (q14d1_rc, q14d2_rc, q14d3_rc, q14d4_rc, q14d5_rc, q14d6_rc, q14d7_rc, q14d8_rc).
- **User satisfaction,** a second-order factor, was created by calculating the mean of the twelve items that were used to create two first-order factors:

  - **Accuracy, ease of use and timeliness,** a first-order factor, was created by calculating the mean of eight items (q14e1_rc, q14e4_rc, q14e5_rc, q14e8_rc, q14e9_rc, q14e10_rc, q14e11_rc, q14e12_rc).
  - **Content and format,** a first-order factor, was created by calculating the mean of four items (q14e2_rc, q14e3_rc, q14e6_rc, q14e7_rc).

Two variables were created from the constructs, as described in the previous paragraph, to denote overall evaluation of the MIS, namely:

- Average of all items (54 questions: q14a1 up to q14e12) across the six MIS success constructs (named: *avgitems*);
- Average of the calculated values of the six MIS success constructs (named: *avgconstr*).

Another set of questions (q14f1 to 14f11) required the participants to provide their overall perception of the quality, performance and success of the entire MIS. These items were included in the questionnaire as a verification measure to validate the responses to the MIS success constructs. Responses to these questions were compared to the variables: *avgitems* and *avgconstr*. The following variables were created from these questions:

- **Overall evaluation,** a second-order factor, was created by calculating the mean of the twelve items that were used to create three first-order components:
  - **Component 1** (Satisfaction with data, outputs and the use of the system), a first-order factor, was created by calculating the mean of six items (q14f1_rc, q14f2_rc, q14f3_rc, q14f4_rc, q14f10, q14f11).
  - **Component 2** (Functioning obstacles), a first-order factor, was created by calculating the mean of three items (q14f5_rcrev, q14f6_rcrev, q14f7_rcrev).
  - **Component 3** (Performance and quality of work related to system), a first-order factor, was created by calculating the mean of three items (q14f8a_rc, q14f8b_rc, q14f9_rc).

Table 8.24 provides descriptive statistics for the MIS success evaluation constructs as described above and Figure 8.15 depicts the mean scores.

Table 8.24. Descriptive statistics of the MIS success evaluation constructs for College 3.

MIS Success Evaluation construct	N	Minimum	Maximum	Mean		Std. Deviation	Variance
	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Statistic
Individual impact	45	1.400	5.000	4.00	0.131	0.876	0.767
Information quality	46	2.300	4.909	3.60	0.099	0.675	0.455
System quality	46	1.917	5.000	3.57	0.092	0.622	0.387
Service quality	43	1.000	5.000	3.44	0.158	1.035	1.070
Organisational impact	46	1.000	5.000	3.53	0.141	0.956	0.913
User satisfaction	46	2.083	4.833	3.67	0.106	0.721	0.520
Overall evaluation	47	2.118	4.796	3.63	0.095	0.654	0.428
Valid N (listwise)	42						

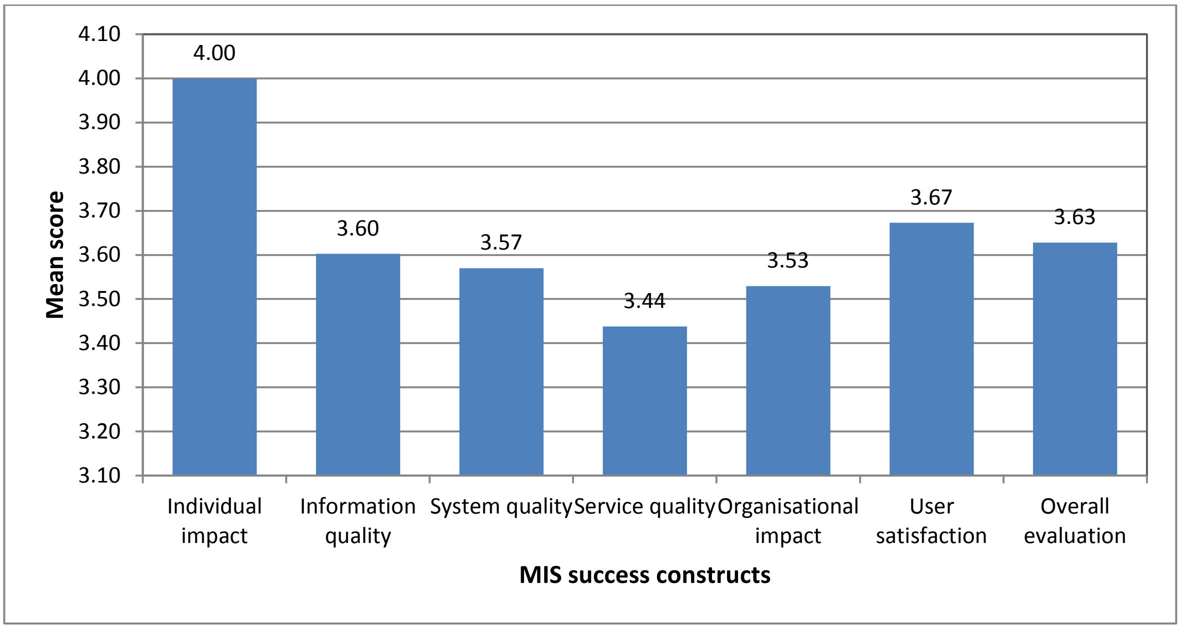


Figure 8.15. Mean scores for each MIS success construct for College 3.

MIS users perceived that the system had a high impact on their individual performance (Mean=4.00). By using the MIS, their awareness and recall of job related information were enhanced and their productivity and effectiveness in their jobs were improved most of the time. The construct that received the second highest average score was user satisfaction (Mean=3.67), which indicated that users valued the content and ease of use of the system and the accuracy, format and timeliness of the data, most of the time. Users rated the quality of the service provider the lowest and thus this component of the MIS needed attention (Mean=3.44) (cf. Table 8.24 and Figure 8.15).

The following section presents findings on an investigation into the relationships between the different measurements of the MIS success constructs.

8.6.5.4. Relationship between the MIS success constructs and the overall evaluation of the MIS

Bivariate correlation procedures were performed to investigate the relationships between MIS success constructs, refer to Table 8.25.

Table 8.25. Kendall's tau_b correlation matrix of MIS success constructs for College 3.

Kendall's tau_b		Individual impact	Information quality	System quality	Service quality	Organisational impact	User satisfaction	Overall evaluation
Individual impact	Correlation Coefficient	1.000						
	Sig. (2-tailed)							
	N	45						
Information quality	Correlation Coefficient	.436**	1.000					
	Sig. (2-tailed)	0.000						
	N	45	46					
System quality	Correlation Coefficient	.344**	.632**	1.000				
	Sig. (2-tailed)	0.002	0.000					
	N	44	45	46				
Service quality	Correlation Coefficient	.396**	.459**	.542**	1.000			
	Sig. (2-tailed)	0.001	0.000	0.000				
	N	42	42	43	43			
Organisational impact	Correlation Coefficient	.461**	.368**	.458**	.637**	1.000		
	Sig. (2-tailed)	0.000	0.001	0.000	0.000			
	N	44	45	46	43	46		
User satisfaction	Correlation Coefficient	.412**	.640**	.556**	.594**	.539**	1.000	
	Sig. (2-tailed)	0.000	0.000	0.000	0.000	0.000		
	N	44	45	46	43	46	46	
Overall evaluation	Correlation Coefficient	.501**	.693**	.687**	.677**	.622**	.779**	1.000
	Sig. (2-tailed)	0.000	0.000	0.000	0.000	0.000	0.000	
	N	45	46	46	43	46	46	47

*. Correlation is significant at the 0.05 level (2-tailed).
**. Correlation is significant at the 0.01 level (2-tailed).

Kendall's tau-b (τb) correlation coefficient (Kendall, 1938) calculation procedures were utilised because it is a non-parametric measure of the strength and direction of association that exists between two variables measured on an ordinal or continuous scale (cf. Chapter 2, section 2.7.5). Pearson's product-moment correlation (Pearson, 1900) could not be used because the data is not normally distributed. Kendall's tau-b procedure was preferred to Spearman's rank-order correlation coefficient (Spearman, 1904) because more accurate generalisations can be drawn from Kendall's statistic than from Spearman's (Field, 2009, p. 175) (cf. Chapter 2, section 2.7.5).

It is evident from Table 8.25 that strong, statistically significant, positive correlations existed among all MIS success constructs and the variable *overall evaluation*. These relationships are depicted in Figure 8.16.

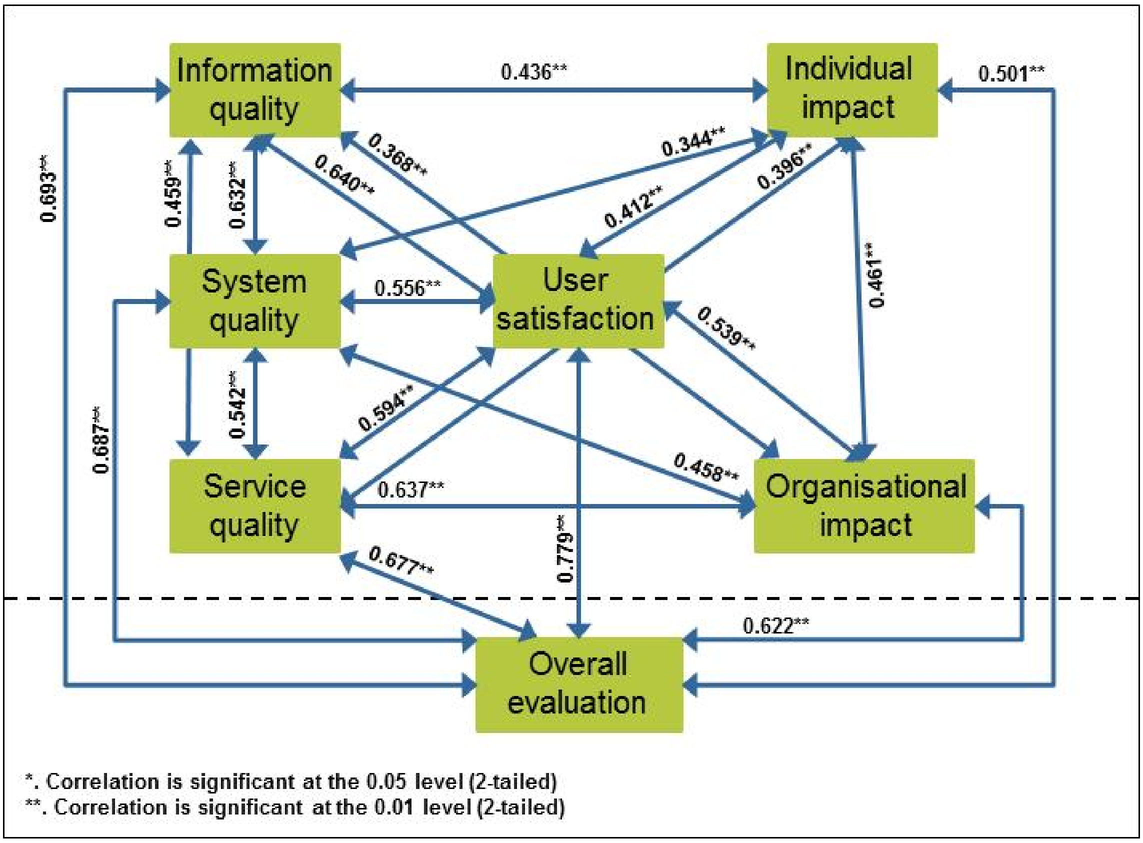


Figure 8.16. Statistically significant positive relationships between MIS success constructs for College 3.

The following section presents an investigation into the predictors of overall satisfaction with the MIS at College 3.

8.6.5.5. Investigate predictor value with regression analysis

The predictor value of the MIS success construct variables to predict the dependent variable, *overall evaluation*, was investigated with regression analysis.

The dependent variable was firstly tested for normality, which is an assumption for linear regression analysis. A Shapiro-Wilk test (Shapiro & Wilk, 1965) was used to test for normality on the dependent variable, *overall evaluation* (cf. Chapter 2, section 2.7.6). The *overall evaluation* variable, $D(47) = 0.973$, $p > 0.05$, was not significant, indicating that the data was normally distributed.

All the MIS success construct variables were used in a multiple regression analysis, in which the Stepwise method was utilised (cf. Chapter 2, section 2.7.7) (Brace, Kemp & Snelgar, 2012). The analysis produced six models as presented in Table 8.26.

In the first model the MIS construct variable, *user satisfaction*, is the only predictor of *overall evaluation* and accounted for 89.2% of the total variance in the dependent variable *overall evaluation* ($R^2 = 0.895$, Adjusted $R^2 = 0.892$). The results in the ANOVA section show that in this model, *user satisfaction* predicted *overall evaluation* of the MIS significantly well ($F = 341.087$, $p<0.05$). The model shows that for each unit increase in *user satisfaction* an increase of 0.873 score points ($\beta = 0.873$, $p<0.05$) can be expected in the dependent variable (*overall evaluation*).

In the sixth model, we observe that all six MIS success construct variables significantly contributed to the dependent variable, *overall evaluation*. The six MIS success construct variables accounted for 98.9% of the total variance in *overall evaluation* ($R^2 = 0.990$, Adjusted $R^2 = 0.989$). The results in the ANOVA section show that in this model, the six independent variables predicted *overall evaluation* of the MIS significantly well ($F = 604.642$, $p<0.05$). By observing the standardised beta coefficients, it is evident that *user satisfaction* ($\beta = 0.343$, $p<0.05$) had the highest contribution to *overall evaluation* of the MIS. System quality ($\beta = 0.211$, $p<0.05$) and information quality ($\beta = 0.187$, $p<0.05$) had the second and third highest contribution to *overall evaluation* of the MIS.

Table 8.26. Results of a multiple regression analysis with *overall assessment* as the dependent variable and *the MIS success construct variables* as independent variables, College 3.

Model Summary				
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.946[a]	0.895	0.892	0.22486882
2	.975[b]	0.951	0.949	0.15556654
3	.984[c]	0.968	0.966	0.12710015
4	.989[d]	0.979	0.977	0.10483243
5	.992[e]	0.985	0.983	0.09032646
6	.995[f]	0.990	0.989	0.07253232
a. Predictors: (Constant), user satisfaction				
b. Predictors: (Constant), user satisfaction, system quality				
c. Predictors: (Constant), user satisfaction, system quality, individual impact				
d. Predictors: (Constant), user satisfaction, system quality, individual impact, service quality				
e. Predictors: (Constant), user satisfaction, system quality, individual impact, service quality, information quality				
f. Predictors: (Constant), user satisfaction, system quality, individual impact, service quality, information quality, organisational impact				

ANOVA[a]						
Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	17.247	1	17.247	341.087	.000[b]
	Residual	2.023	40	0.051		
	Total	19.270	41			
2	Regression	18.326	2	9.163	378.625	.000[c]
	Residual	0.944	39	0.024		
	Total	19.270	41			
3	Regression	18.656	3	6.219	384.954	.000[d]
	Residual	0.614	38	0.016		
	Total	19.270	41			
4	Regression	18.863	4	4.716	429.110	.000[e]
	Residual	0.407	37	0.011		
	Total	19.270	41			
5	Regression	18.976	5	3.795	465.170	.000[f]
	Residual	0.294	36	0.008		
	Total	19.270	41			
6	Regression	19.086	6	3.181	604.642	.000[g]
	Residual	0.184	35	0.005		
	Total	19.270	41			
a. Dependent Variable: overall evaluation						
b. Predictors: (Constant), user satisfaction						
c. Predictors: (Constant), user satisfaction, system quality						
d. Predictors: (Constant), user satisfaction, system quality, individual impact						
e. Predictors: (Constant), user satisfaction, system quality, individual impact, service quality						
f. Predictors: (Constant), user satisfaction, system quality, individual impact, service quality, information quality						
g. Predictors: (Constant), user satisfaction, system quality, individual impact, service quality, information quality, organisational impact						

Coefficients[a]						
Model		Unstandardised Coefficients		Standardised Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	0.434	0.176		2.462	0.018
	user satisfaction	0.873	0.047	0.946	18.469	0.000
2	(Constant)	-0.015	0.139		-0.108	0.915
	user satisfaction	0.617	0.050	0.669	12.262	0.000
	system quality	0.387	0.058	0.364	6.677	0.000
3	(Constant)	-0.156	0.118		-1.322	0.194
	user satisfaction	0.520	0.047	0.563	11.171	0.000
	system quality	0.368	0.048	0.346	7.722	0.000
	individual impact	0.141	0.031	0.178	4.519	0.000
4	(Constant)	-0.040	0.101		-0.401	0.691
	user satisfaction	0.426	0.044	0.462	9.692	0.000
	system quality	0.317	0.041	0.298	7.740	0.000
	individual impact	0.146	0.026	0.185	5.674	0.000
	service quality	0.112	0.026	0.171	4.343	0.000
5	(Constant)	-0.053	0.087		-0.612	0.544
	user satisfaction	0.372	0.041	0.403	9.150	0.000
	system quality	0.241	0.041	0.227	5.926	0.000
	individual impact	0.121	0.023	0.153	5.242	0.000
	service quality	0.125	0.023	0.191	5.550	0.000
	information quality	0.149	0.040	0.151	3.720	0.001
6	(Constant)	-0.039	0.070		-0.563	0.577
	user satisfaction	0.317	0.035	0.343	9.102	0.000
	system quality	0.224	0.033	0.211	6.804	0.000
	individual impact	0.101	0.019	0.128	5.306	0.000
	service quality	0.072	0.021	0.111	3.374	0.002
	information quality	0.185	0.033	0.187	5.574	0.000
	organisational impact	0.109	0.024	0.156	4.564	0.000
a. Dependent Variable: overall evaluation						

Excluded Variables[a]						
Model		Beta In	t	Sig.	Partial Correlation	Collinearity Statistics Tolerance
1	individual impact	.206[b]	3.320	0.002	0.469	0.544
	information quality	.322[b]	4.819	0.000	0.611	0.377
	system quality	.364[b]	6.677	0.000	0.730	0.422
	service quality	.254[b]	3.553	0.001	0.495	0.399
	organisational impact	.255[b]	3.424	0.001	0.481	0.373
2	individual impact	.178[c]	4.519	0.000	0.591	0.539
	information quality	.177[c]	2.936	0.006	0.430	0.288
	service quality	.161[c]	3.027	0.004	0.441	0.367
	organisational impact	.196[c]	3.876	0.000	0.532	0.363
3	information quality	.116[d]	2.162	0.037	0.335	0.264
	service quality	.171[d]	4.343	0.000	0.581	0.366
	organisational impact	.173[d]	4.327	0.000	0.580	0.358
4	information quality	.151[e]	3.720	0.001	0.527	0.258
	organisational impact	.111[e]	2.473	0.018	0.381	0.248
5	organisational impact	.156[f]	4.564	0.000	0.611	0.235
a. Dependent Variable: overall evaluation						

Excluded Variables[a]						
Model		Beta In	t	Sig.	Partial Correlation	Collinearity Statistics Tolerance
b. Predictors in the Model: (Constant), user satisfaction						
c. Predictors in the Model: (Constant), user satisfaction, system quality						
d. Predictors in the Model: (Constant), user satisfaction, system quality, individual impact						
e. Predictors in the Model: (Constant), user satisfaction, system quality, individual impact, service quality						
f. Predictors in the Model: (Constant), user satisfaction, system quality, individual impact, service quality, information quality						

The next section provides a brief summary of some of the main findings in the three case studies.

8.7. Summary of findings on the three cases

The results and findings presented in the previous three sections (sections 8.4, 8.5 and 8.6) on each selected college are notably different from each other, which provide evidence that the demonstration of the applicability of the artefact (TVET-MIS-EVAL methodology) was successfully conducted. The calculated measurement of each MIS success construct and the overall evaluation provide evidence that the artefact is useful. The artefact was evaluated to demonstrate its worth with evidence addressing criteria such as validity, utility, quality and efficacy.

The rest of this section highlights some of the main findings in the characteristics of the colleges that resulted from the evaluation of the MIS by using the TVET-MIS-EVAL methodology.

It is interesting to note the differences in staff proportions involved with MIS responsibilities in the respective colleges: in College 1, 5% of the staff worked on the MIS, whilst in College 2 and College 3 it was 3% and 10% respectively (cf. Table 8.2). College 1 and College 2, which displayed lower MIS maturity levels, had the smallest staff component involved with the MIS. This could be ascribed to a variety of factors including: management challenges (not much emphasis placed on ICT in the college); limitations on human resources (too few staff available to support the MIS); financial constraints; or for information security and protection of student confidentiality reasons (only a few staff members are entrusted with MIS activities). The latter was confirmed by Interviewee 3 (2015) for College 2. Nonetheless, a small staff involvement can result in an overburdening of staff which, in turn, can negatively impact upon the performance of an ICT unit. The ICT unit should, in reality, support the effective functioning of the MIS as well as strategic management and planning on college and national levels by maintaining the quality of data inputs and outputs. Some of the main findings are compared in Table 8.27.

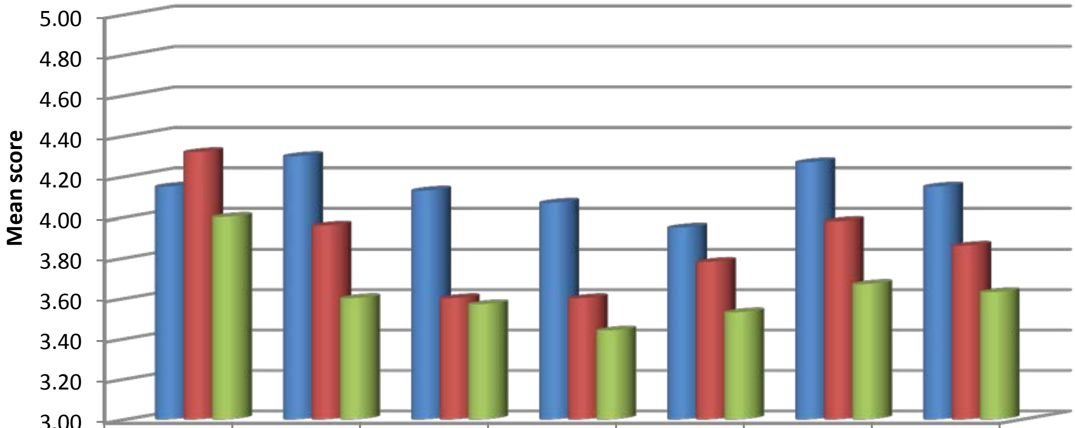
Table 8.27. Some of the findings from the application of the TVET-MIS-EVAL methodology on the selected cases.

Category	College 1 (Low MIS maturity level)	College 2 (Average MIS maturity level)	College 3 (Above average MIS maturity level)
MIS management	Small staff component at each campus consisted of lecturing and support staff. Users were mainly young – all users were younger than 35 years.	Small staff component at each campus consisted of management and support staff. Users were mainly older – 77% were older than 30 years, 23% were 40 years or older.	Large staff component consisted of management, lecturing and support staff. 56% of the users were younger than 35 years and 41% were 40 years or older.
MIS age	More or less than one year.	13 years (started using the system in 2004).	More than 10 years.
Highest rated item	'How often does the information content meet your needs?' had the highest mean score of 4.83.	'Information from the MIS is important' had the highest mean score of 4.45.	'The MIS enhances my awareness of job related information' had the highest mean score of 4.10.
Lowest rated item	'The output reports from the system are consistent and accurate' had the lowest mean score of 2.40.	'The MIS user interface (screen) can be easily adapted to one's personal approach (customise)' had the lowest mean score of 2.77.	'The output reports from the system are consistent and accurate' had the lowest mean score of 2.79.
MIS success construct scores (Mean(SE)):			
Individual impact	4.15 (0.282)	4.32 (0.149)	4.00 (0.131)
Information quality	4.30 (0.182)	3.96 (0.150)	3.60 (0.099)
System quality	4.13 (0.294)	3.60 (0.166)	3.57 (0.092)
Service quality	4.07 (0.313)	3.60 (0.254)	3.44 (0.158)
Organisational impact	3.95 (0.152)	3.78 (0.211)	3.53 (0.141)
User satisfaction	4.27 (0.260)	3.98 (0.154)	3.67 (0.106)
Overall evaluation	4.15 (0.174)	3.86 (0.136)	3.63 (0.095)

While more in-depth investigation at each college will be necessary to fine-tune interventions for the improvement of the efficiency of the MISs, high level observations indicating where possible improvements to the system are needed, can be made. Users of the MIS in College 1 clearly indicated that they were almost always satisfied with the quality of the information (Mean=4.30) contained in the MIS, but that they are concerned about the accuracy and consistency of the output reports from the system (Table 8.27). College 1 users furthermore did not perceive that the system had a significant impact on the organisation (Mean=3.95). Users of the MIS at College 2 and College 3 valued the impact of the MIS on their productivity and efficiency in their jobs highly (Mean=4.32 and Mean=4.00, respectively). The results revealed that the quality of services from the MIS service provider of College 2 has to be improved.

A high-level comparison of the measurements by college (Figure 8.17) showed that College 1 had the highest scores on all MIS success constructs, except for the construct *individual impact*. One should remember that the MIS at College 1 had been newly implemented (age of more or less than one year) (Interviewee 5, 2015). Users at College 3 rated their MIS consistently lower than the other two colleges. During the interview with two of College 3's managers it was mentioned that the college management was contemplating purchasing and migrating to another system (Interviewee 2, 2015). No mention of dissatisfaction with the system, used at the time, was made. The MIS used by College 3 was developed and maintained by an individual person and the college viewed this as a major risk (Interviewee 2, 2015).

It is acknowledged that one should be careful when comparing results across colleges without taking other influential contextual factors into consideration - factors such as user characteristics, college culture and system characteristics. The selected colleges were utilising different MISs (cf. section 5.4.1). A valuable characteristic of the artefact is in identifying weaknesses in the system where users experience challenges. These challenges can then be further investigated and solutions or interventions can be suggested and implemented. A specific MIS can then be evaluated again, over time, to ascertain whether the solutions or interventions had a positive effect.



	Individual impact	Informa-tion quality	System quality	Service quality	Organisa-tional impact	User satisfaction	Overall evaluation
College 1	4.15	4.30	4.13	4.07	3.95	4.27	4.15
College 2	4.32	3.96	3.60	3.60	3.78	3.98	3.86
College 3	4.00	3.60	3.57	3.44	3.53	3.67	3.63

Figure 8.17. Comparison of the mean scores of all MIS success constructs by college.

Based on the demonstration of the artefact on the three cases, suggestions for improvements to the TVET-MIS-EVAL methodology (artefact) are presented in the following section.

8.8. Suggestions for refinements to the TVET-MIS-EVAL methodology (Artefact)

The previous sections presented evidence of the applicability of the TVET-MIS-EVAL methodology (artefact) on public TVET Colleges. The artefact was demonstrated and evaluated using three cases; each randomly selected from clusters of colleges with different MIS maturity levels. The robustness of the artefact was enhanced by the fact that it could be demonstrated and evaluated on MISs with different maturity levels.

Enhancements to the TVET-MIS-EVAL methodology, based on the observations made during the demonstration and evaluation of the artefact, are as follows:

- The results derived from the application of the TVET-MIS-EVAL methodology should be interpreted by reflecting on contextual factors such as institutional culture, staff and college characteristics.
- An institution that is considering using the TVET-MIS-EVAL methodology (artefact) to evaluate its MIS must ensure proper commitment of all its users to achieve the goal of evaluating their MIS. Emphasis should be placed on the importance of honesty in their responses. If the success evaluation of the MIS is conducted in-house and not outsourced, the users should participate anonymously.
- Dedicated and diligent management staff should lead the operations with regard to the utilisation of the TVET-MIS-EVAL methodology. Thus, the utilisation of the artefact should be led by high profile management officials to ensure the successful evaluation of the deployed MIS.
- Phase D: Toolkit, as presented in section 6.3.4, can be utilised flexibly. The demonstration and evaluation of the artefact on the three selected cases (as presented in this chapter) reiterated the flexibility characteristic of the toolkit of the TVET-MIS-EVAL methodology. A wide range of statistical techniques can be used to measure the MIS success constructs, as long as the results satisfy the requirement of validity – it measures what it is supposed to measure.
- The MIS maturity level of the system deployed at the college must be taken into consideration when utilising the TVET-MIS-EVAL methodology and interpreting the results. As mentioned in section 5.4, and again experienced in the demonstration and evaluation of the artefact on the three selected cases, the MIS relies heavily on the ICT platform utilised at the college (Cosser, Kraak & Winnaar, 2011).
- Internet connectivity should also be taken into consideration when evaluating the success of the MIS. This aspect proved to be an important factor to MIS success because different campuses communicate via email and are linked to the head office to upload data (e.g. student registration and examination information) by using internet connections.
- The age of a system is an important factor to consider before investing in MIS success evaluation. An age indicator can perhaps be an interaction

variable with, and linked to, MIS maturity levels. It is suggested that (perhaps as a rule of thumb) a system should have been implemented and used for more than two years before a realistic and holistic MIS success evaluation can be conducted.

The following chapter presents the conclusion of the study.

CHAPTER 9. SYNTHESIS OF FINDINGS, DISCUSSION, CONCLUSION, LIMITATIONS AND RECOMMENDATIONS

"A research study commences as a thunderstorm, tumultuously signifying the process of intense thought wrestles. After relentless struggles with the definition of the problem statement, project conceptualisation, research design, and planning, the storm, at long last, surrenders and gives way to a stage of steady and strong rainfall - the period of project execution. The accumulated knowledge gives birth to well-defined emerging streamlets. The conclusion and reflection stages symbolise clear skies and a wide river flowing peacefully."

- Anonymous

9.1. Introduction

In this concluding chapter, the reflections on and conclusions from the investigation of the problem, its formulation, the project objectives and the knowledge gained from the extensive literature reviews are discussed. Key findings are summarised and recommendations are made about the successfully developed and evaluated TVET-MIS-EVAL methodology. Findings derived from the innovative evidence-based sample selection technique are also discussed. Areas of future research are proposed, limitations of this project are noted, and overall conclusions are outlined.

The purpose of the study was to design and develop a methodology for the evaluation of MISs and public TVET Colleges in South Africa.

The objectives of the study, as presented in Chapter 1 section 1.2.4, were firstly to review and interrogate the usefulness of existing literature on the components of a methodology and on methodology development and, secondly, to investigate existing MIS success evaluation models that can be used in the development of the methodology (artefact). The third objective was to investigate the context, including the main characteristics of the public TVET College sector, and the MISs deployed at these institutions. The final objective was to evaluate the developed methodology (artefact) on a sample of public TVET Colleges towards the refinement of the artefact.

9.2. Research overview

The research problem of the study was informed by the fact that the Department of Higher Education and Training (DHET) in South Africa views the growth and development of the public TVET College sector as part of its strategy to improve the quality of education in the country. The DHET's focus aims to alleviate the shortage of intermediate-level and artisanal skills, which contributes to high levels of unemployment in South Africa. Thus, efficient and effective management and accurate decision-making within these institutions are essential. To ensure reliable data and information, which is not only beneficial to the college but also to the DHET, the evaluation of the management information systems (MISs) within these institutions that provide data and information to inform institutional short-term and long-term management decision-making and day-to-day operations, should take place on a regular basis.

The fact that no evidence of a methodology (artefact) for the evaluation of MISs at public TVET Colleges in South Africa could be found in the literature initiated this problem-centred study and underpins its rationale. Based on the background, problem statement and rationale for the study, the main research question for the study was formulated as: *What are the components that constitute a methodology for the evaluation of a MIS at a public TVET College in South Africa?* (cf. section 1.2.3.1).

The following sub-research questions were defined in support of the investigation of the main research question:

- What are the components of a methodology? (cf. section 1.2.3.2).
- What models exist to support the success evaluation of MISs at public TVET Colleges? (cf. section 1.2.3.3).
- What are the main characteristics of the research context and the MIS deployed at public TVET Colleges? (cf. section 1.2.3.4).

- How do the results of the evaluation of the MISs at public TVET Colleges compare and contribute to the evaluation of the developed methodology (artefact)? (cf. section 1.2.3.5).

During the execution of the research, when the developed artefact (cf. Chapter 6, section 6.3) had to be evaluated, another sub-sub-research question arose, which was: *How can an evidence-based quantitative method be used for case selection in information systems research? (cf. Chapter 7, section 7.1).*

The following section presents evidence that the research questions were answered by showing where in the study each was addressed and by briefly describing the derived findings.

9.3. Thesis questions answered

The investigation into the components constituting a methodology for the evaluation of a MIS at a public TVET College in South Africa (main research question), was successfully conducted. Research of each sub-research question assisted in addressing the main research question by serving as building blocks towards the construction of the TVET-MIS-EVAL methodology.

9.3.1. First sub-research question answered

Information about the examination of the first sub-research question is presented in Table 9.1 and shows that the literature review led to a clear comprehension of the term: *methodology.* Furthermore, a synthesis of exemplars of methodologies found in the literature informed the proposed conceptual framework for the TVET-MIS-EVAL methodology.

Table 9.1. Sub-research question one answered.

Topic	Description
Sub-research question 1:	What are the components of a methodology?
Addressed in:	Chapter 3
Main findings (outputs):	The literature review on methodologies and methodology development revealed that a methodology consists of two dimensions, namely, a philosophical dimension and a technical dimension. A methodology is thus embedded in a philosophical paradigm. A methodology furthermore incorporates a technical dimension, which refers to the methods

Topic	Description
	and techniques used when utilising the methodology. The most suitable philosophical paradigm adopted for the TVET-MIS-EVAL methodology was pragmatism. An investigation into exemplars of methodologies found in the literature together with a hermeneutic approach led to the conclusion that an appropriate conceptual framework of components for the TVET-MIS-EVAL methodology (Artefact) should include the following: Phase A: Principles Phase B: Guidelines, practices and rules Phase C: Procedures Phase D: Toolkit Phase E: Standards and values

9.3.2. Second sub-research question answered

During the examination of the second sub-research question, 14 models for the success evaluation of MISs were found in the literature and were considered for suitability to be included in the TVET-MIS-EVAL methodology. Six empirically tested questionnaires, also found in the literature, informed an item bank from which items were selected for inclusion in the tools (instruments) for the TVET-MIS-EVAL methodology. Table 9.2 shows that the enquiry into this sub-research question was presented in Chapter 4 and that the SA-FETMIS model (cf. Chapter 4, section 4.6.14), which is based on the DeLone and McLean IS success model (cf. Chapter 4, section 4.6.9), was selected for inclusion in the TVET-MIS-EVAL methodology.

Table 9.2. Sub-research question two answered.

Topic	Description
Sub-research question 2	What models exist to support the success evaluation of MISs at public TVET Colleges?
Addressed in:	Chapter 4
Main findings (outputs):	The SA-FETMIS success model for the evaluation of MISs was found most suitable and was selected for inclusion in the component: Phase C: Procedure of the TVET-MIS_EVAL methodology. A mixed methods data analysis approach was also found to be fitting for inclusion in Phase C: Procedure. A survey questionnaire was developed for inclusion in the Phase D: Toolkit component of the TVET-MIS-EVAL methodology (cf. Appendix E). A semi-structured interview schedule was developed for inclusion in Phase D: Toolkit (cf. Appendix D).

9.3.3. Third sub-research question answered

The third sub-research question was answered in Chapter 5, as noted in Table 9.3. A literature study investigating the historical background, developments, investments and interventions, waves of change and the type of MIS deployed at the public TVET Colleges was conducted. This was done to gain a deeper understanding of the public TVET College sector, which is the context of the study. The investigation revealed that the sector has undergone many changes in a short period of time resulting in much vulnerability. It was also found that three different types of MIS are being used by the colleges and that the specifications of the systems are aligned with the data requirements of the DHET. The systems' developers are very responsive to changes in DHET's data requirements and updates to the systems happen thus promptly when required. The knowledge gained during this literature review informed the components: *Phase A: Principles* and *Phase B: Guidelines, practices and rules* of the TVET-MIS-EVAL methodology.

Table 9.3. Sub-research question three answered.

Topic	Description
Sub-research question 3	What are the main characteristics of the research context and the MIS deployed at public TVET Colleges?
Addressed in:	Chapter 5
Main findings (outputs):	The literature review on the public TVET College sector informed the components: *Phase A: Principles* and *Phase B: Guidelines, practices and rules* of the TVET-MIS-EVAL methodology.

9.3.4. Fourth sub-research question answered

Addressing the fourth sub-research question of the study involved the activities of demonstration and evaluation of the newly developed TVET-MIS-EVAL methodology. A crucial aspect of the development of an artefact within the design science research (DSR) paradigm is that the artefact has to be evaluated as part of the iterative build-and-evaluate processes within DSR. Before an evaluation of the TVET-MIS-EVAL methodology could be performed, cases on which it could be applied needed to be selected. This presented a major challenge because the cases needed to be representative of the population of public TVET Colleges based on characteristics of the deployed MIS. The aim of the demonstration and evaluation of the TVET-MIS-EVAL methodology was to suggest improvements to the artefact and to achieve enhanced robustness. Purposive and convenient sampling techniques were therefore not considered rigorous enough and therefore an investigation into an appropriate sample selection technique was initiated. An innovative evidence-based technique, as described in Chapter 7, was designed, developed and implemented to cluster the colleges. One college was randomly selected from each of the clusters.

The TVET-MIS-EVAL methodology was demonstrated on and evaluated at the three selected cases and the results and findings were presented in Chapter 8. Refinements to the TVET-MIS-EVAL methodology were suggested and described in section 8.8.

Table 9.4. Sub-research question four answered.

Topic	Description
Sub-research question 4	How do the results of the evaluation of the MISs at public TVET Colleges compare and contribute to the evaluation of the developed methodology (artefact)?
Addressed in:	Chapter 7 and Chapter 8
Main findings (outputs):	Chapter 7: Presented an innovative evidence based cluster-random sampling technique. Three colleges with different levels of MIS maturity were selected for the demonstration and evaluation of the TVET-MIS-EVAL methodology. Chapter 8: The TVET-MIS-EVAL methodology was applied on the selected colleges and the findings informed refinements to the TVET-MIS-EVAL methodology, as presented in Chapter 6.

9.3.5. Main research question answered

Conclusions drawn from the literature reviews conducted for the purpose of answering the first three sub-research questions informed, and were used, as building blocks in the construction of the TVET-MIS-EVAL methodology. The TVET-MIS-EVAL methodology was designed, developed and constructed in Chapter 6, section 6.3.

The fourth sub-research question was answered through the application of the artefact on the selected cases. The developed methodology was demonstrated on and evaluated at the three selected cases. Findings derived from the application of the artefact on the three cases informed refinements to the developed TVET-MIS-EVAL methodology. These refinements were recorded in Chapter 8, section 8.8.

Table 9.5. Main research question answered.

Topic	Description
Main research question:	What are the components that constitute a methodology for the evaluation of a MIS at a public TVET College in South Africa?
Addressed in:	Chapter 6 (section 6.3) including the suggested refinements in Chapter 8 (section 8.8).
Main findings (outputs):	The TVET-MIS-EVAL methodology was presented in Chapter 6. The information collected during literature reviews in Chapters 3, 4 and 5 informed the development of the artefact and was used as building blocks for the construction of the artefact. The TVET-MIS-EVAL methodology was applicable to the three selected cases and findings derived from the application of the artefact informed refinements to the developed TVET-MIS-EVAL methodology.

The following section provides information on the process followed in conducting the research.

9.4. Summary of the research design

The design science research process (DSRP) model (cf. section 2.4.4), for producing and presenting information systems research, suggested by Peffers *et al*. (2006, p. 93), underpinned the research process of the study. The research process of the study is illustrated in Figure 9.1 and extensively explicated in Chapter 2 (cf. section 2.5). The shaded part of Figure 9.1 situates this chapter within the research process of the study. The phases of the research process are briefly described as follows:

Phase 1: The study was introduced, the background to the study, problem statement, purpose and research questions were presented. This phase relates to the first activity in the DSRP model proposed by Peffers *et al*. (2006), which is: *identify problem and motivation of relevance*. Chapter 1 was the output of Phase 1.

Phase 2: The description of the research design and methodology of the study were constructed during this phase. Chapter 2 was the output of this phase.

Phase 3: Phase 3 corresponds to the second DSRP model activity (Peffers *et al.*, 2006), which is: *define objectives of a solution*. Literature studies were conducted with the aim of informing the development of the required artefact (*methodology)* for the evaluation of a MIS at a public TVET College in South Africa. In this phase, information about the development of a methodology (cf. Chapter 3); models for the evaluation of MISs (cf. Chapter 4) and MISs at public TVET Colleges (cf. Chapter 5) were collected and conclusions were drawn in support of the construction of the required artefact.

Phase 4: The third activity in the DSRP model, *Design and development* (Peffers *et al.*, 2006) of the *TVET-MIS-EVAL methodology* (artefact) for the evaluation of MISs at public TVET Colleges, was conducted during this phase. The outputs from Chapters 3, 4 and 5 were used to develop the artefact presented in Chapter 6.

Phase 5: A sample of cases was selected based on an innovative evidence-based cluster-random selection technique (cf. Chapter 7). The colleges were clustered based on their level of MIS maturity. Three cases were selected, one from each cluster.

Phase 6: The developed artefact (named the TVET-MIS-EVAL *methodology*) was *demonstrated* (fourth activity in the DSRP model (Peffers *et al.*, 2006) and *evaluated* (fifth activity in the DSRP model (Peffers *et al.*, 2006) by using the selected cases as part of the iterative build-and-evaluate processes within the DSRP model to refine and evaluate the developed TVET-MIS-EVAL methodology. Data collection, analysis and reporting were conducted as part of the processes in the iterative refinement of the artefact. Suggestions for refinements to the TVET-MIS-EVAL methodology (artefact) are presented in Chapter 8.

Phase 7: Dissemination of documented findings, discussions and conclusions were presented, which corresponds to the sixth and final activity in the DSRP model (Peffers *et al.*, 2006) which is *communication of research and results* (cf. Chapter 9). A research article based on the innovative evidence-based cluster-random sample selection technique was published in the *South African Journal of Information Management* (SAJIM) on 22 March 2017.

	INPUT	PROCESS	OUTPUT
PHASE 1	Literature: Theory, literature, reports, documents, expert discussion and interviews with stakeholders.	Literature review. Introduction to the research problem: *Identify problem and motivation of relevance.*	**Chapter 1:** Introduction to the research study, problem statement and motivation of relevance.
PHASE 2	Information in **Chapter 1.** Literature: theories, models, methods.	Design and develop the research methodology. Literature review: philosophies, paradigms, strategies.	**Chapter 2:** Research design and methodology on how the research problem was addressed.
PHASE 3	**Chapter 1 and 2**. Theory, literature, reports, documents, expert discussion and interviews with stakeholders on: • Methodology development; • IS success evaluation; • MIS at public TVET colleges.	Literature review: the literature studies, document analysis and inferences initialise and address the design science research process (DSRP) model activity: *Define objectives of a solution.*	Production of: • **Chapter 3:** Components of a methodology – output: framework for artefact. • **Chapter 4:** IS success evaluation models – output: model for artefact. • **Chapter 5:** MIS at public TVET colleges: context.
PHASE 4	Information in **Chapters 1-5.**	*Design and development* (Third activity in DSRP) of the initial methodology (artefact) for the evaluation of MIS at public TVET colleges.	**Chapter 6:** Developed TVET-MIS-EVAL methodology including procedures, methods, guidelines, data collection instruments, etc.
PHASE 5	• Theory on Web Maturity Models (WMM) →	• Design questionnaire based on WMM and evaluate public TVET colleges' websites →	• Dataset on website characteristics of public TVET colleges
	• Dataset on characteristics of colleges' websites →	• Cluster analysis →	• Three clusters of public TVET colleges
	• Clusters of colleges →	• Random selection of one college per cluster →	• Sample of three colleges **Chapter 7**
PHASE 6	Developed TVET-MIS-EVAL methodology – **Chapter 6.** Selected cases – **Chapter 7.**	DSRP activities: *Demonstrate, Evaluate, Communicate.* Also referred to as *design-demonstrate-evaluate* and *build-and-evaluate* iterations. Demonstration and evaluation - College 1; Demonstration and evaluation - College 2; Demonstration and evaluation - College 3; Optimized evaluation methodology (artefact)	**Chapter 8:** • Findings from demonstration and evaluation on College 1 • Findings from demonstration and evaluation on College 2 • Findings from demonstration and evaluation on College 3 • Refinements to the TVET-MIS-EVAL methodology (artefact)
PHASE 7	**Chapter 1-8**	Conclude, synthesise, reflect, write and collate (DSRP activity: *Communicate*).	**Chapter 9:** Conclusion

Figure 9.1. Research process of the study delineated by phases, inputs, activities and outputs, underpinned by the design science research process (DSRP) model (Peffers *et al.*, 2006, p. 93).

The next section presents a reflection on key findings of the research.

9.5. Reflection on key findings

Extensive literature reviews culminated in the design, development and construction of the TVET-MIS-EVAL methodology as the required artefact of the study. The application of the developed artefact, on three cases, informed refinements to the artefact. The innovative evidence-based sampling technique also presented significant findings on a clustering method and practical results with regards to public TVET College clusters in South Africa.

Key findings were as follows:

- The *conceptual framework* consisting of five components of the required artefact (TVET-MIS-EVAL methodology) was informed by the literature study presented in Chapter 3 on methods, methodologies and paradigms. The conceptual framework presented in Table 3.4 was the first building block towards the construction of the required artefact.
- The literature review, as presented in Chapter 4, was conducted to search for appropriate procedures, models, methods and instruments suitable for inclusion in the required artefact. The SA-FETMIS success model (cf. sections 4.6.14 and 4.7) was found to be a suitable model for inclusion in the component: *Phase C: Procedure* of the artefact. It was furthermore found that a combination of five empirically tested instruments (cf. Table 4.6) found in the literature were suitable to inform the component: *Phase D: Toolkit* of the required artefact.
- The main finding of the study was that it was possible to design, develop and construct the required artefact, which was presented in Chapter 6.
- It was furthermore found that it was possible to group the population of public TVET Colleges into groups with similar levels of MIS maturity by using website maturity as a proxy for MIS maturity (cf. Chapter 7). Three groups emerged from the analysis: colleges without website or websites on a low maturity level; colleges with websites on an average; and colleges with websites on above average maturity levels.
- The innovative evidence-based case selection technique utilised to cluster and select the sample of cases can be generalised to any other knowledge domain and research study in which a more rigorous method of case selection than convenient or purposive sampling is required. The step-by-step method is presented in Appendix G.
- The constructed artefact was successfully applied on three cases which informed refinements to the developed artefact. This satisfied the design science research requirement for the *evaluation* of the artefact.
- An important overall finding was that the use of existing IT infrastructure at the TVET Colleges can be used for the evaluation of the MIS deployed at the college by using the TVET-MIS-EVAL methodology.

A brief overview of the structure of the thesis and the content of each chapter is presented in the following section.

9.6. Chapter summary

The structure of the thesis is underpinned by the *publication schema* for IS research as presented by Gregor and Hevner (2013, p. 350) and summarised by Goes (2014, p. vi). Table 1.5 links the sections of the publication schema (Gregor & Hevner, 2013) for IS research to the chapters of the study. The content of each chapter can briefly be summarised as follows:

Chapter 1: Introduction

In Chapter 1 the research problem was defined and the significance of the research study motivated. Theoretical grounding in terms of the underpinning philosophical paradigm and key concepts of the relevant knowledge domains were introduced. The research questions, objectives, scope of the study, overview of methods, theoretical and practical significance and ethical considerations of the study were presented.

Chapter 2: Research design and methodology

In Chapter 2 the research design and methodology used to develop the required artefact was explicated. The process model of the study was presented and explained. Data collection and data analysis methods used in the study were introduced and delineated.

Chapter 3: Components of a methodology

The aim of Chapter 3 was to present a framework for a *methodology* (artefact) suitable for the evaluation of MISs at public TVET Colleges in South Africa. Thus, the first sub-research question in support of the main research question namely: *What are the components of a methodology?* (cf. section 1.2.3.2) was addressed in Chapter 3. The literature review focused on definitions and descriptions of concepts, constructs and components within the knowledge domain of methods, methodologies and paradigms. Chapter 3 concluded with a conceptual framework for the TVET-MIS-EVAL methodology (artefact) for the evaluation of MISs at public TVET Colleges in South Africa. The framework of the TVET-MIS-EVAL methodology consisted of five components: *Phase A: Principles*, *Phase B: Guidelines, practices and rules*, *Phase C: Procedures*, *Phase D: Toolkit* and *Phase E: Standards and values* (cf. Table 3.4).

Chapter 4: Models for the evaluation of management information systems

In Chapter 4, the literature was reviewed in search for models for the evaluation of information systems, applicable to public TVET Colleges in South Africa. The literature review focused on the second sub-research question in support of the main research question of the study namely: *What models exist to support the evaluation of MISs at public TVET Colleges?* (cf. section 1.2.3.3). Hence, the information gathered and analysed in Chapter 4 provided theoretical impetus to the development of the components, *Phase C: Procedures* and *Phase D: Toolkit,* of the TVET-MIS-EVAL methodology (artefact) as proposed in Chapter 3 (cf. Table 3.4). The SA-FETMIS success model was selected to serve as the basis of the proposed theoretical base model for the *procedures* and *toolkit* phases of the TVET-MIS-EVAL methodology (artefact).

Chapter 5: Public TVET Colleges and MISs deployed

The literature reviewed and described in Chapter 5 focused on the third sub-research question in support of the main research question of the study namely: *What are the main characteristics of the research context and the MIS deployed at public TVET Colleges?* (cf. section 1.2.3.4). Thus, the information presented in Chapter 5 provided support for the relevance of the research problem and it also informed the development of the components, *Phase A: Principles*, *Phase B: Guidelines, practices and rules* and *Phase C: Procedures* of the TVET-MIS-EVAL methodology, as presented in Chapter 3 (cf. Table 3.4).

Chapter 6: TVET-MIS-EVAL methodology (artefact)

The artefact (TVET-MIS-EVAL methodology) was presented in Chapter 6. The artefact was designed, developed and constructed using the knowledge building blocks gained through extensive literature reviews in the fields of:

- Methods, methodologies and paradigms, which was described in Chapter 3;
- Models utilised for success evaluation of MISs, which was presented in Chapter 4; and
- A description of the context of MISs deployed at public TVET Colleges in South Africa, which was provided in Chapter 5.

It is important to remember that the information in Chapters 3, 4 and 5 formed part of the building process of the artefact. Thus, the main research question: *What are the components that constitute a methodology for the success evaluation of a MIS at a public TVET College in South Africa?* is partly addressed in Chapter 6. The presented artefact still needed to be evaluated.

Chapter 7: Clustering of public TVET Colleges and sample selection

In design science research (DSR) it is imperative to evaluate the newly created artefact (Hevner *et al.*, 2004). A sample of colleges was needed for the application of the artefact. Chapter 7 contains a description of an innovative, evidence-based sample selection technique that was used to select cases on which the TVET-MIS-EVAL methodology could be applied and evaluated. Firstly, the population of public TVET Colleges was clustered according to the maturity level of their websites, which was used as a proxy for the maturity level of their MISs. Secondly, one college was randomly selected from each cluster. This ensured that the artefact could be applied (demonstrated and evaluated) on colleges with different levels of MIS maturity. A journal article based on the content of Chapter 7 was published in the South African Journal of Information Management (SAJIM) in 2017 (Visser, van Biljon & Herselman, 2017). It is important to note that the application of the artefact on colleges with different MIS maturity levels contributed to enhanced rigour and generalisability of the artefact to all public TVET Colleges.

Chapter 8: Artefact demonstration and evaluation through case studies towards suggestions for refinements to the TVET-MIS-EVAL methodology

The activities described in Chapter 8 correspond to the fourth and fifth design science research process (DSRP) model activities, which are the demonstration and evaluation of the created artefact (Peffers *et al.*, 2006). Chapter 8 consists of the results and findings that emerged from the application of the artefact on the selected sample of colleges. The final sub-research question was furthermore addressed in Chapter 8, which is: *How do the results of the evaluation of the MISs at public TVET Colleges compare and contribute to the evaluation of the developed methodology?* (cf. section 1.2.3.5). Successful demonstration and evaluation of the developed artefact were conducted and suggestions for refinements to the artefact were presented.

Chapter 9: Conclusion

Chapter 9 contains a synthesis of the study, which includes a summary of the chapters, an overview of the research process, reflection on the findings, significance and contribution of the research, delineation and assumptions of the study, scientific, methodological and personal reflections and possible topics for future research.

The following section presents the significance and contribution of the research.

9.7. Contribution to knowledge

The findings that emerged from the study contribute to the discourse in the Information System's knowledge domain by showing how a methodology has been developed in the design science research (DSR) paradigm. The novelty of the research study lies in the production of a *methodology* (artefact) to evaluate a MIS in the context of an educational domain by utilising DSR. Evidence of artefacts designed by using DSR such as constructs, models, methods, instantiations and theories could be found in the literature, but no evidence of a *methodology* developed by using DSR was found.

The study contributes to theory for design and action as classified by Gregor (2006) and the developed artefact satisfies the conditions of importance, parsimony and novelty on a micro-level (Weber, 2012). The main theoretical and practical contribution of this research study was the evaluated *TVET-MIS-EVAL methodology* (artefact), which IT specialists, MIS managers and data managers at public TVET Colleges can use on a regular basis to evaluate the MIS deployed at their institutions.

The innovative evidence-based cluster-random sample selection method, by which the population of public TVET Colleges was grouped, was an additional contribution to the domain of sample selection of cases. The step-by-step description of the technique, as presented in Appendix G, can be applied to any other knowledge domain when more rigorous methods than convenient or purposive sample selection of cases are required.

In terms of its policy significance, the developed *methodology* (artefact) can assist in generating public evidence to increase accountability and allow for improvement in service delivery systems. The utilisation of the TVET-MIS-EVAL methodology (artefact) can contribute practically to the quality of, firstly, the MIS deployed at the public TVET College and, secondly, to the quality of the data and information produced by the MIS for reporting to the DHET. Enhanced decision-making by college management can contribute to enhanced efficiency and effectiveness of the public TVET College. A well-functioning MIS can provide valuable information to decision-makers at the local college and the national DHET level on which type of interventions should be implemented for effective improvement of educational outcomes for public TVET College students in South Africa. Findings from applying the *methodology* (artefact) can furthermore assist policy-makers and programme managers in identifying gaps, strengths and weaknesses in the MIS.

Since the developed artefact was applied and evaluated on colleges with different levels of MIS maturity, the artefact is generalisable within the public TVET College domain and can be used by all public TVET Colleges.

The next section presents the delineation and assumptions of the study.

9.8. Delineation and assumptions of the research study

While considering the research problem and the importance of the study, the following assumptions were made:

- The aim of the study was to develop an artefact for the purpose of evaluating MISs deployed at public TVET Colleges in South Africa. The artefact (TVET-MIS-EVAL methodology) was developed and evaluated on public TVET Colleges in South Africa and is therefore generalisable to public TVET Colleges in South Africa. Its applicability to educational institutions in other countries still needs to be evaluated. Similarly, its applicability to other types of institutions can also be investigated in future.
- An assumption for the study was that all concepts within the developed artefact should be defined and used from a *MIS success evaluation* perspective and not from a *human computer interaction* (HCI) perspective.
- It was decided to investigate a rigorous sample selection technique, other than purposive or convenient sampling techniques. An evidence-based clustering method was developed and used to group the population of public TVET Colleges in clusters displaying similar MIS maturity levels. Only one college was randomly selected from each of the three clusters. The assumption was that each selected college was representative of the cluster from which it was selected.
- A decision was taken to source empirically tested instruments from the literature to inform the toolkit component of the artefact. The realised instruments can in future be revised with the aim of item reduction. Fewer items might sufficiently measure the MIS success constructs.

The mentioned assumptions can be considered as guidelines for future areas of research. The next section provides scientific, methodological and personal reflections on the study.

9.9. Three reflections on the study

The following sections respectively present scientific, methodological and personal reflections with regard to the study.

9.9.1. Scientific reflection

The study was about the development of a *methodology* (artefact) for the evaluation of management information systems at public TVET Colleges.

Literature studies revealed that the most prominent philosophical paradigms in IS research are positivism, interpretivism, pragmatism, critical realism, constructivism, design science and behaviourism. An investigation into these paradigms proved design science research, supported by pragmatism, to be the most suitable paradigm for the development of the required artefact (cf. Chapter 2, sections 2.3 and 2.4).

An in-depth study about processes, models and methods in the design science research paradigm directed the execution of the study (cf. Chapter 2, section 2.4.1). The Information Systems Research Framework, as presented by Hevner *et al*. (2004, p. 80), informed the theoretical framework of the study (cf. section 2.4.2). The process model of the study was informed by the activities described by Peffers *et al*. (2006, p. 93) in the design science research process (DSRP) model. After considering exemplars of methodologies found in the literature, the conceptual framework of the required artefact of the study, itself was informed by the design science research methodology (DSRM) (Peffers *et al.*, 2008) (cf. Chapter 3, section 3.4). An investigation into 14 IS success models for inclusion in the required artefact was conducted (cf. Chapter 4, section 4.6) and it was found that the SA-FETMIS success model (Visser, van Biljon & Herselman, 2013, p. 4) which is based on the DeLone and McLean IS success model (DeLone & McLean, 1992, p. 63) was the most suitable for inclusion in the required artefact. A search for empirically tested instruments to measure the different MIS success constructs for inclusion in the toolkit of the required artefact, was performed through literature reviews (cf. Chapter 4, section 4.10). The final developed instruments included in the toolkit of the required artefact were informed by six empirically tested instruments (questionnaires) found in the literature.

The information presented in this section provides evidence that the study was based on, and was characterised by, the methods and principles of science. The following section provides a methodological reflection.

9.9.2. Methodological reflection

The following questions were answered to reflect on the methodology utilised during the execution of the study:

Was the chosen research methodology the best for answering the research questions?

The study was concerned with the design and development of a *methodology* (artefact) for the success evaluation of a MIS at a public TVET College in South Africa. Methods, procedures and guidelines incorporated in the design science research paradigm were utilised for the execution of the study. The design science paradigm is a problem solving paradigm which is proactive in the sense that it seeks solutions to problems through creation and/or innovation of IT artefacts including constructs, models, methods and instantiations (March & Smith, 1995; Hevner *et al.*, 2004; Goes, 2014). Design science supports a pragmatic philosophical paradigm which considers thought as a tool for prediction, problem solving and action. The focus in a pragmatic philosophical paradigm is on practical application - theories or beliefs are evaluated with the view of how successful they are in practice (Goldkuhl, 2012). Findings from literature reviews, as presented in Chapters 3, 4 and 5, together with interpretation thereof by using the hermeneutic cycle, formed part of the building process of the artefact. The process model of the study was informed by the design science research process (DSRP) model which includes the following activities: identify problem and motivate relevance; define objectives of a solution; design and development of an artefact; demonstration; evaluation; and communication (Peffers *et al.*, 2006, p. 93). The developed artefact was evaluated in a controlled environment (sample of three colleges) for its applicability which is one of the design science evaluation methods suggested by Hevner *et al*. (2004, p. 86).

Considering the above mentioned, it can be concluded that an appropriate methodology was used to address the research problem.

Were the samples used in the research justifiable?

During the fourth (*demonstration*) and fifth (*evaluation*) activities of the DSRP model (Peffers *et al.*, 2006, p. 93), which underpin Phase 6 of the process model of the study (cf. section 9.4), a sample of colleges was needed for the demonstration and evaluation of the developed artefact. A carefully selected sample, representative of the population of public TVET Colleges, was needed to be able to generalise the applicability of the newly developed artefact to all public TVET Colleges. It was decided to firstly use an innovative evidence-based technique to cluster all public TVET Colleges according to their MIS maturity level. This was done by using the level of website maturity of each college as a proxy for MIS maturity. Inferential statistical procedures, as described in detail in Chapter 7, were used to cluster the colleges by using data collected on the website characteristics of the population of public TVET Colleges. The statistical procedures produced three clusters. One college from each cluster was randomly selected and the developed artefact was demonstrated and evaluated at the selected colleges.

It is believed that the procedure utilised was an appropriate, innovative and novel way to conduct sample selection of cases and that the selection of diverse cases contributed to the robustness of the developed artefact.

During the application of the artefact, instruments contained in the artefact (Phase D: Toolkit) were used to collect data to measure the success of the MIS at the college. Five officials participated in interviews and 69 MIS users completed the survey questionnaire across institutions, as presented in Table 9.6. It is believed that the sample of interviewees was sufficient to gain a deep qualitative understanding of operations at the college and of the functionality of the deployed MIS. The samples of participants in the surveys were large enough for the application of inferential statistical procedures to calculate measurements for the required MIS success constructs.

Table 9.6. Number of interviews conducted and participants in the survey.

Institution	Interviews	Participants in survey (Response rate)
Department of Higher Education (DHET)	1	
College 1	1	8 (53%)
College 2	1	14 (88%)
College 3	2	47 (100%)
Total	5	69

Were the data analysis techniques justifiable?

Data analysis techniques were utilised as part of Phase D: Toolkit of the artefact during the demonstration and evaluation of the artefact. The following data analysis techniques were used: exploratory data analysis (including frequencies, mean, maximum, minimum, standard deviation, standard error), Weighted Average Index (WAI), Principal Component Analysis (PCA), Cronbach's Alpha, Kendall's tau-b correlation coefficients, Shapiro-Wilk test for normality and Linear Regression analysis. A detailed description of the different data analysis techniques is presented in Chapter 2, section 2.7. The listed data analysis techniques were utilised for the calculation of the MIS success construct measurements separately for each selected college, as presented in Chapter 8. By considering the results obtained from the application of the data analysis techniques, as described in Chapter 8, it is believed that the selection and application of these data analysis techniques are defensible.

9.9.3. Personal reflection

I strongly believe that the successful completion of the research study relied heavily on the following aspects: firstly, a clearly formulated, stated and focused research problem; secondly, a realistic and detailed study plan with specific objectives linked to specific due dates; and thirdly, motivation, discipline and perseverance. In all these aspects the guidance and knowledge of my skilled and experienced supervisors was crucial and contributed substantially to the level of my motivation and the success of the study.

I experienced many challenges of which I believe the biggest were to balance work related demands and family responsibilities with time to work on the study. I had to travel long distances to visit the selected public TVET Colleges and had to fit in these journeys between work responsibilities. Even though I am a researcher by profession, I have gained much theoretical knowledge about methodologies, philosophical paradigms, design science research, artefact development and inferential statistical procedures. In-depth knowledge of how public TVET Colleges operate was enriching. Looking back on the study path, it was a very rich, intense and rewarding experience.

9.10. The way forward

This section gives a reflection on generalisability and areas of future academic and practical research.

9.10.1. Generalisability

Two main contributions from the study to the knowledge domain in terms of generalisability are evident. Firstly, the innovative evidence-based case selection technique developed in this study to cluster and select the sample of cases can be generalised to any other knowledge domain, context or research study, in which a more rigorous method of case selection than convenient or purposive sampling is required, due to its reliance on evidence. The step-by-step method is provided in Appendix G.

Secondly, the TVET-MIS-EVAL methodology has been demonstrated and evaluated at three public TVET Colleges. The three colleges were selected from clusters characterised by different levels of MIS maturity. This contributed to enhanced rigour and applicability of the artefact and it is therefore suitable for application to the population of public TVET Colleges.

9.10.2. Areas for future academic and practical research

The following research topics could be investigated in future to broaden the collective understanding of this specific knowledge domain:

- Future research could be done to establish the effectiveness of the *TVET-MIS-EVAL methodology* at public TVET Colleges. An explorative evaluation of its support and benefits in practice could be done. For instance, the artefact could be evaluated for its effectiveness in establishing more control, better monitoring and governance or standardisation and the support for unified language use. Wells (2012) can be consulted for an example of such practices in the literature.

- The developed artefact (TVET-MIS-EVAL methodology) can be evaluated for its suitability to other contexts such as TVET Colleges in other countries or to other types of institutions, for example, in contexts other than educational.
- Future research could also focus on further refinement of the *procedures* and *toolkit* components of the methodology (artefact). Research studies could be conducted to inform Phase C: Procedures and Phase D: Toolkit of the TVET-MIS-EVAL methodology. Other methods, models or procedures could be tested for inclusion in these phases to measure MIS success constructs.

The following section presents concluding remarks about the study.

9.11. Conclusion

The foci of this study were, firstly, on the development of a methodology (artefact) for the evaluation of a MIS at a public TVET College in South Africa; secondly, on the selection of a representative sample of cases on which the artefact could be evaluated; and thirdly, on the application and refinement of the developed artefact.

A combination of well-established existing theories was used to conduct the study. The TVET-MIS-EVAL methodology (artefact) was designed and developed by utilising design science research principles, practices and guidelines supported by pragmatism.

During the evaluation of the TVET-MIS-EVAL methodology, quantitative and qualitative data were collected and analysed as part of Phase D: Toolkit, by using mixed methods (Quan-qual), where the implemented MIS at a public TVET College served as the case being studied.

The study has demonstrated "*what the components [are] that constitute a methodology for the success evaluation of a MIS at a public TVET College in South Africa"* through the developed and empirically evaluated *TVET-MIS-EVAL methodology*.

REFERENCES

Adapt IT (2016). *Adapt IT - Solutions & Services for Education*. [Online]. Available from: http://www.adaptit.co.za/Industries/Pages/Education.aspx. [Accessed: 30 November 2016].

Ahituv, N. (1980). A systematic approach toward assessing the value of an information system. *MIS Quarterly*. 4. pp. 61-75.

Ajzen, I. (1985). From intentions to actions: A theory of planned behavior. In *Action control* (pp. 11-39). Springer Berlin Heidelberg.

Al-Adaileh, R.M.D. (2009). An evaluation of information systems success: A user perspective - the case of Jordan Telecom Group. *European Journal of Scientific Research*. 37. pp. 226-239.

Alkin, M. C. (Ed.). (2012). *Evaluation roots: A wider perspective of theorists' views and influences*. Sage Publications.

Arbnor, I. & Bjerke, B. (2009). *Methodology for creating business knowledge*. Thousand Oakes, California: SAGE Publications, Inc.

Atkins, M.H. (1994). Information technology and information systems perspectives on business strategies. *Journal of Strategic Information Systems*. 3 (2). pp. 123-135.

Babbie, E.R. (1990). *Survey research methods*. Wadsworth.

Baehr, M. (2004). *Evaluation Methodology*. [Online]. Available from: http://www.pcrest.com. [Accessed: 10 February 2016].

Baets, W. (1992). Aligning information systems with business strategy. *Journal of Strategic Information Systems*. 1 (4). pp. 205-213.

Bagozzi, R.P. & Warshaw, P.R. (1992). Development and test of a theory of technological learning and usage. *Human Relations*. 45. pp. 660-686.

Bailey, J.E. & Pearson, S.W. (1983). Development of a Tool for Measuring and Analysing Computer User Satisfaction. *Management Science*. 29 (5). pp. 530-545.

Bandura, A. (1977). Self-efficacy: toward a unifying theory of behavioral change. *Psychological review*. 84 (2). pp. 191-215.

Benbasat, I., Goldstein, D.K., & Mead, M. (1987). The Case Research Strategy in Studies of Information Systems. *MIS Quarterly.* 11 (3) pp. 369-386

Ben-Zvi, D., Bakker, A. & Makar, K. (2015). Learning to reason from samples. *Educational Studies in Mathematics*. [Online]. 88. pp. 291-303. Available from: http://link.springer.com/article/10.1007/s10649-015-9593-3/fulltext.html. [Accessed: 11 April 2015].

Bharati, P. (2003). People and information matter: Task support satisfaction from the other side. *The Journal of Computer Information Systems*. 43 (2). pp. 93-103.

Bhattacherjee, A., & Premkumar, G. (2004). Understanding changes in belief and attitude toward information technology usage: A theoretical model and longitudinal test. *MIS quarterly*. 28 (2). pp. 229-254.

Bhorat, H., Hirsch, A., Kanbur, R., & Ncube, M. (Eds.). (2014). The oxford companion to the economics of South Africa. OUP Oxford.

Blustein, D.L., Franklin, A.J., Makiwane, M. & Gutowski, E. (2017). Unemployment in South Africa. In: Stead, G.B. & Watson, M.B. (eds). *Career psychology in the South African context*. 3rd ed. Pretoria: Van Schaik. pp. 195-208.

Bottema, A. (2014). How can management dashboards support best practice governance and management in the TVET sector at both colleges and DHET level? In: *Together forging a vibrant Technical and Vocational Education and Training system in South Africa*. 2014, Pretoria, South Africa.

Brace, N., Snelgar, R., & Kemp, R. (2012). SPSS for Psychologists. Palgrave Macmillan.

Bresnick, A. & Schaeffer, G. (1999). *Managing information systems: A practical assessment tool.*

Brynjolfsson, E., Hitt, L. & Yang, S. (2002). Intangible assets: how computers and organizational structure affect stock market valuations. *Brookings Papers on Economic Activity*. 1. pp. 137-198.

Burgess, S., Sellitto, C. & Karanasios, S. (2009). *Effective Web Presence Solutions for Small Businesses: Strategies for Successful Implementation*. Hershey, PA, USA: IGI Global.

Caccam, M. & Refran, J. (2012). *Cluster Analysis*. [Online]. Slideshare. Available from: http://www.slideshare.net/jewelmrefran/cluster-analysis-15529464. [Accessed: 19 March 2015].

Carden, F. & Alkin, M.C. (2012). Evaluation Roots: An International Perspective. *Journal of MultiDisciplinary Evaluation*. [Online]. 8 (17). pp. 102-118. Available from: http://www.ipdet.org/files/Publication-Evaluation_Roots_-_An_International_Perspective.pdf. [Accessed: 20 April 2016].

CDC (2016). *Types of Evaluation*. [Online]. Available from: http://www.cdc.gov/std/Program/pupestd/Types%20of%20Evaluation.pdf. [Accessed: 6 April 2016].

Chakravarti, I.M., Laha, R.G. & Roy, J. (1967). *Handbook of Methods of Applied Statistics*. [Online]. Hoboken: John Wiley & Sons Ltd. Available from: http://www.scirp.org/(S(351jmbntvnsjt1aadkposzje))/reference/ReferencesPapers.aspx?ReferenceID=789020. [Accessed: 24 June 2017].

Chang, J.C.J. & King, W.A. (2000). The development of measures to assess the performance of the information systems function: A multiple-constituency approach. In: *Proceedings of the twenty first international conference on Information systems*. 2000, Atlanda, GA, USA: Association for Information Systems (AIS), pp. 640-646.

Chatterjee, S. (2015). Writing my next Design Science Research masterpiece: but how do I make a theoretical contribution to DSR? In: *Proceedings of the 23rd European Conference on Information Systems*. [Online]. 2015, Münster, Germany, pp. 1-12. Available from: https://balsa.man.poznan.pl/indico/event/44/material/paper/0?contribId=281. [Accessed: 11 January 2016].

Checkland, P. (1981). *Systems Thinking, Systems Practice*. Chichester, U.K.: Wiley.

Cleven, A., Gubler, P. & Hüner, K.M. (2009). *Design Alternatives for the Evaluation of Design Science Research Artifacts*. In: 2009.

Cohen, J. (1960). A coefficient for agreement for nominal scales. *Education and Psychological Measurement*. 20. pp. 37-46.

COLTECH (2011). Coltech Computer Training - Product Overview. *Hotfrog Do Business Differently*. [Online]. Available from: http://www.hotfrog.co.za/business/gt/pretoria-gardens/coltech/coltech-computer-training-product-overview-61905. [Accessed: 25 October 2016].

COLTECH (2016). *Coltech Computer Training an Innovative Approach to Student Management Needs*. [Online]. 2016. Available from: http://www.coltech.co.za/. [Accessed: 22 November 2016].

Cosser, M. (2012). FET College Sector Fails to Meet Great Expectations. *NGO Pulse SANGONeT*. [Online]. Available from: http://www.ngopulse.org/article/fet-college-sector-fails-meet-great-expectations#comment-form. [Accessed: 29 June 2013].

Cosser, M., Kraak, A. & Winnaar, L. (2011). *Further Education and Training (FET) Colleges at a Glance in 2010. FET Colleges Audit, May - July 2010, commissioned by the National Board for Further Education and Training, subsumed by the DHET*.

Creswell, J.W. (1994). *Research design: qualitative and quantitative approaches*. Thousand Oakes, California: SAGE Publications, Inc.

Creswell, J.W. (2003). *Research design: qualitative, quantitative, and mixed methods approaches*. Thousand Oakes, California: SAGE Publications, Inc.

Creswell, J.W. (2008). *Mixed methods research: design and procedures*. [Online]. Available from: http://www.up.ac.za/. [Accessed: 28 January 2016].

Creswell, J.W. (2014). *Research Design: Qualitative, Quantitative, and Mixed Methods Approaches*. Fourth. SAGE Publication Ltd. Thousand Oaks: California, London, New Delhi, Singapore, Washington DC.

Creswell, J.W. & Plano Clark, V.L. (2011). *Designing and Conducting Mixed Methods Research*. Second Edition. SAGE Publication Ltd. London.

Cronbach, L.J. (1951). Coefficient alpha and the internal structure of tests. *Psychometrika*. 16 (3). pp. 297-334.

Cross, N. (2001). Designerly Ways of Knowing: Design Discipline vs. Design Science. *Design Issues*. [Online]. 17 (3). pp. 49-55. Available from: http://oro.open.ac.uk/3281/1/Designerly-_DisciplinevScience.pdf. [Accessed: 15 January 2016].

Crotty, M. (1998). *The Foundation of Social Research: Meaning and Perspective in the Research Process*. SAGE Publication Ltd. London.

Crowe, S., Creswell, K., Robertson, A., Huby, G., Avery, A. & Sheikh, A. (2011). The case study approach. *BMC Medical Research Methodology*. [Online]. 11 (100). pp. 1-9. Available from: http://www.biomedcentral.com/1471-2288/11/100. [Accessed: 13 January 2017].

Curtis, S., Gesler, W., Smith, G. & Washburn, S. (2000). Approaches to sampling and case selection in qualitative research: examples in the geography of health. *Social Science & Medicine*. 50. pp. 1001-1014.

Cyert, R.M. & March, J.G. (1963). *A behavioural theory of the firm*. Engelwood Cliffs, New Jersey: Prentice-Hall.

Dalhousie University (2015). *Criteria for websites. Evaluating Web Resources*. [Online]. Dalhousie University. Available from: http://libraries.dal.ca/using_the_library/evaluating_web_resources/6_criteria_for websites.html. [Accessed: 19 March 2015].

Davis, F.D. (1985). *A Technology Acceptance Model for empirically testing new end-user information systems: Theory and Results*. PhD in Management. Massachusetts Institute of Technology: Sloan School of Management.

Davis, F.D. (1989). Perceived usefulness, perceived ease of use, and user acceptance of information technology. *MIS Quarterly*. 13. pp. 319-340.

Davis, F.D. (1993). User acceptance of information technology: system characteristics, user perceptions and behavioral impacts. *Man-Machine Studies*. 38. pp. 475-487.

Davis, F.D., Bagozzi, R.P. & Warshaw, P.R. (1989). User Acceptance of Computer Technology: A Comparison of Two Theoretical Models. *Management Science*. 35. pp. 982-1003.

Davis, G. 2005. Advising and Supervising, in *Research in Information Systems*: *A Handbook for Research Supervisors and Their Students*, D. Avison and J. Pries-Heje (eds.), Amsterdam: Elsevier Butterworth Heinemann.

Davison, R.M., Vreede, G.-J. de. & Briggs, R.O. (2005). On peer review standards for the information systems literature. *Communications of the Association for Information Systems*. 16 (4). pp. 967-980.

del Mar, V. (2011). *Introducing UNESCO's Technical Vocational Education and Training (TVET) definition and strategy*. [Online]. United Nations Educational, Scientific and Cultural Organization (UNESCO). Available from: http://www.uis.unesco.org/StatisticalCapacityBuilding/. [Accessed: 13 September 2015].

DeLone, W.H. & McLean, E.R. (1992). Information Systems Success: The Quest for the Dependent Variable. *Information Systems Research*. 3 (1). pp. 60-95.

DeLone, W.H. & McLean, E.R. (2003). The DeLone and McLean Model of Information Systems Success: A Ten-year Update. *Journal of Management Information Systems*. 19 (4). pp. 9-30.

DeLone, W.H. & McLean, E.R. (2004). Measuring e-Commerce Success: Applying the DeLone & McLean Information Systems Success Model. *International Journal of Electronic Commerce*. 9 (1). pp. 31-47.

Denzin, N.K. & Lincoln, Y.S. (2008). *Strategies of Qualitative Inquiry*. Third edition. United States of America: SAGE Publication Ltd.

Denzin, N.K. & Lincoln, Y.S. (2011). *The SAGE Handbook of Qualitative Research*. Fourth. [Online]. Thousand Oaks, CA: Sage. Available from: https://uk.sagepub.com/en-gb/afr/the-sage-handbook-of-qualitative-research/book233401. [Accessed: 10 December 2016].

Department of Geography, UNT (2010). *Normality Tests in SPSS*. [Online]. Available from: http://geography.unt.edu/~wolverton/Normality%20Tests%20in%20SPSS.pdf. [Accessed: 24 June 2017].

DHET (2006). *Further Education and Training Colleges Act 16 of 2006*. [Online]. Pretoria: Department of Higher Education and Training (DHET). Available from: http://www.saqa.org.za/. [Accessed: 25 March 2015].

DHET (2011). *Revised Strategic Plan, 2010/11 - 2014/15, and operational plans for the 2011/12 finacial year*. Pretoria, South Africa: Department of Higher Education and Training (DHET).

DHET (2012a). *2010/11-2014/15 Strategic Plan Revised version: March 2012.* Pretoria: Department of Higher Education and Training.

DHET (2012b). *Green paper for post-school education and training*. [Online]. Pretoria: Pretoria: Department of Higher Education and Training. Available from: www.dhet.gov.za. [Accessed: 2 April 2013].

DHET (2013). *Specifications for load files for the Technical and Vocational Education and Training Management Information System (TVETMIS) - TVETMIS File Specifications Version: Version 001 (2015/10/05)*. [Online]. Available from: https://webapps.dhet.gov.za/TECHNICA.aspx. [Accessed: 11 November 2015].

DHET (2014). *White Paper for Post-School Education and Training: Building an expanded effective and integrated Post-School Education System*. [Online]. Pretoria, South Africa: Department of Higher Education and Training (DHET). Available from: http://www.gpwonline.co.za. [Accessed: 12 August 2017].

DHET (2015a). *Developing Strategic, Annual Performance and Operational Plans for TVET Colleges*. [Online]. Pretoria, South Africa: Department of Higher Education and Training (DHET). Available from: http://www.dhet.gov.za/Public%20FET%20Colleges/Planning%20Templates%20and%20Guidelines/2016%20TVET%20College%20Planning%20Guidelines%20(Amended%20Final%2023-07-2015).pdf. [Accessed: 15 July 2017].

DHET (2015b). *Statistics on Post-School Education and Training in South Africa: 2013*. Pretoria: Department of Higher Education and Training (DHET).

DHET (2015c). *Strategic Plan 2015/16-2019/20*. [Online]. Pretoria, South Africa: Department of Higher Education and Training (DHET). Available from: http://www.dhet.gov.za/Strategic%20Plans/Strategic%20Plans/Department%20of%20Higher%20Education%20and%20Training%20Strategic%20Plan%202015-16%20-%202019-20.pdf. [Accessed: 15 July 2017].

DHET (2016a). *Annual Performance Plan 2016/17*. [Online]. Pretoria, South Africa: Department of Higher Education and Training (DHET). Available from: http://www.dhet.gov.za/Strategic%20Plans/Annual%20Perfomance%20Plans/Department%20of%20Higher%20Education%20and%20Training%20Annual%20Performance%20Plan%20%202016-17.pdf. [Accessed: 15 July 2017].

DHET (2016b). *Statistics on Post-School Education and Training in South Africa: 2014*. Pretoria, South Africa: Department of Higher Education and Training (DHET).

DHET (2017). *Statistics on Post-School Education and Training in South Africa: 2015*. [Online]. Pretoria, South Africa: Department of Higher Education and Training (DHET). Available from: http://www.dhet.gov.za/DHET%20Statistics%20Publication/Statistics%20on%20Post-School%20Education%20and%20Training%20in%20South%20Africa%202015.pdf. [Accessed: 11 April 2017].

Dishaw, M.T., Strong, D.M. & Brandy, D.B. (2002). Extending the Task-Technology Fit Model with self-efficacy constructs. *Association for Information Systems AIS Electronic Library (AISeL). AMCIS 2002 Proceedings*. [Online]. Available from: http://aisel.aisnet.org/cgi/viewcontent.cgi?article=1502&context=amcis2002. [Accessed: 23 September 2017].

DMReview (2016). Glossary. *Information-Management.com*. [Online]. Available from: http://www.information-management.com/glossary/m.html. [Accessed: 13 January 2016].

DoE (2008). *National Plan for Further Education and Training Colleges in South Africa*. Pretoria: Pretoria: Department of Education.

Doll, W.J. & Torkzadeh, G. (1988). The Measurement of End-User Computing Satisfaction. *MIS Quarterly*. 12 (2). pp. 259-274.

Drechsler, A. & Hevner, A. (2016). *A four-cycle model of IS design science research: capturing the dynamic nature of IS artifact design*. In: 2016, St. John, Canada, pp. 1-8.

DST (2007). *Towards 2018: South Africa's 10-year national innovation plan*. Pretoria: Pretoria: Department of Science and Technology.

DTi (2012). *Industrial Policy Action Plan 2012/13 - 2014/15*. Pretoria: Pretoria: Department of Trade and Industry.

Duignan, P. (2001). Introduction to Strategic Evaluation: Section on Evaluation Approaches, Purposes, Methods and Designs. *Introduction to Strategic Evaluation*. [Online]. Available from: http://www.parkerduignan.com/documents/104.htm. [Accessed: 24 March 2016].

Dwivedi, Y.K., Wastell, D., Laumer, S., Henriksen, H.Z., Myers, M.D., Bunker, D., Elbanna, A., Ravishankar, M.N. & Srivastava, S.C. (2015). Research on information systems failures and successes: Status update and future directions. *Information Systems Front*. 17. pp. 143-157.

Dzvapatsva, G.P., Mitrovic, Z., & Dietrich, A.D. (2014). Use of social media platforms for improving academic performance at Further Education and

Training Colleges', *South African Journal of Information Management.* 16(1), Art. #604, 7 pages. Available from: http://dx.doi. org/10.4102/sajim.v16i1.604. [Accessed: 18 March 2016].

Earthy, J., Jones, B.S. & Bevan, N. (2001). The improvement of human-centred processes - facing the challenge and reaping the benefit of ISO 13407. *International Journal of Human-Computer Studies*. [Online]. 55 (4). pp. 553-585. Available from: http://www.idealibrary.com. [Accessed: 11 April 2015].

EDD (2010). *The new growth path: Accord 1, National Skills Accord*. [Online]. Pretoria: Economic Development Department. Available from: Pretoria: http://www.info.gov.za/view/DownloadFileAction?id=149083. [Accessed: 22 April 2013].

Elliott, A.C. & Woodward, W.A. (2007). *Statistical Analysis Quick Reference Guidebook: With SPSS Examples*. SAGE Publication Ltd. London.

Esterhuizen, D., Schutte, C., & du Toit, A. (2012). A knowledge management framework to grow innovation capability maturity. *South African Journal of Information Management*. 14(1), Art. #495, 10 pages. Available from: http://dx.doi.org/10.4102/sajim.v14i1.495. [Accessed: 11 March 2016].

ETDP SETA (2012). *ETDP SETA public Further Education and Training sector skills plan 2013/14 update*. [Online]. ETDP SETA. Available from: www.etdpseta.org.za. [Accessed: 7 July 2013].

Ewusi-Mensah, K. (2003). *Software development failures: anatomy of abandoned projects*. The MIT Press, Cambridge, Massachusetts.

Fath-Allah, A., Cheikhi, L., Al-Qutaish, R.E. & Idri, A. (2014). E-Government Maturity Models: A Comparative Study. *International Journal of Software Engineering & Applications*. 5 (3). pp. 71-91.

Feild, L., Pruchno, R.A., Bewley, J., Lemay, E.P. & Levinsky, N.G. (2006). Using Probability vs. Nonprobability Sampling to Identify Hard-to-Access Participants for Health-Related Research: Costs and Contrasts. *Journal of Aging andHealth*. 18 (4). pp. 565-583.

Field, A.P. (2006). Intraclass Correlation. In: *Encyclopedia of Statistics in Behavioural Science, Volume 2*. John Wiley and Sons Ltd. Chichester, UK, pp. 948-954.

Field, A.P. (2009). *Discovering Statistics Using SPSS*. Third Edition. London: SAGE Publication Ltd.

Field, A.P. & Hole, G. (2003). *How to Design and Report Experiments*. SAGE Publications Ltd.

Fishbein, M. & Ajzen, I. (1975). *Belief, attitude, intention, and behavior: An introduction to theory and research*. Reading, MA: Addison-Wesley.

Available from: http://people.umass.edu/aizen/f&a1975.html. [Accessed: 12 August 2017].

Fleiss, J.L. (1971). Measuring nominal scale agreement among many raters. *Psychological Bulletin*. 76 (5). pp. 378-382.

Flyvbjerg, B. (2006). Five Misunderstandings About Case-Study Research. *Qualitative Inquiry*. 12(2). pp. 219-245. Available from: http://qix.sagepub.com/content/12/2/219.abstract. [Accessed: 10 November 2016].

Fowler, F.J. (2009). *Survey research methods*. Fourth. Thousand Oaks, California: SAGE Publication Ltd.

Freeze, R.D., Alshare, K.A., Lane, P.L. & Joseph Wen, H. (2010). IS Success Model in E-Learning Context Based on Students' Perceptions. *Journal of Information Systems Education*. 21 (2). pp. 173-184.

Gable, G.G., Sedara, D. & Chan, T. (2008). Re-conceptualizing Information System Success: The IS-Impact Measurement Model. *Journal of the Association for Information Systems*. 9 (7). pp. 377-408.

Gallagher, C.A. (1974). Perceptions of the value of a management information system. *Academy of Management Journal*. 17. pp. 46-55.

Galletta, D. & Zhang, P. (2006). *Applications of Human-Computer Interaction in Management Information Systems. In: GALLETTA, D. & ZHANG, P. (Eds.) HCI and MIS: Applications, Series of Advances in Management Information Systems*. M.E. Sharpe publisher.

Galliers, R.D. (2003). Change as Crisis or Growth? Toward a Trans-disciplinary View of Information Systems as a Field of Study: A Response to Benbasat and Zmud's Call for Returning to the IT artifact. *Journal of the Association for Information Systems*. 4 (6). pp. 337-351.

Goes, P.B. (2014). Editor's comments: Design Science Research in Top Information Systems Journals. *MIS Quarterly*. 38 (1). pp. iii-viii.

Goldkuhl, G. (2004). *Meanings of Pragmatism: Ways to conduct information systems research*. In: [Online]. 2004, Linköping: Forskningsgruppen VITS. Available from: http://www.vits.org/konferenser/alois2004/html/6901.pdf, and http://www.vits.org/?pageId=37&UltimateMenu1B=Item21. [Accessed: 28 January 2016].

Goldkuhl, G. (2008). What kind of Pragmatism in Information Systems Research? *AIS SIG Prag Inaugural meeting, Paris*.

Goldkuhl, G. (2012). Pragmatism vs interpretivism in qualitative information systems research. *European Journal of Information Systems*. 21 (2). pp. 135-146.

Goldkuhl, G. & Lind, M. (2010). A Multi-Grounded Design Research Process. In: *R. Winter, J.L. Zhao, and S. Aier (Eds.): DESRIST 2010, LNCS 6105*. 2010, Berlin, Heidelberg: © Springer-Verlag, pp. 45-60.

Goodhue, D.L. & Thompson, R.L. (1995). Task-Technology Fit and Individual Performance. *MIS Quarterly*. 19 (2). pp. 213-236.

Gorla, N., Somers, T.M. & Wong, B. (2010). Organizational impact of system quality, information quality, and service quality. *Journal of Strategic Information Systems*. 19. pp. 207-228.

Government of SA. (2009). *Human Resource Development Strategy for South Africa (HRD-SA) 2010 - 2030*. Pretoria: Government of South Africa.

Government of SA. (2010). *The new growth path: The framework*. [Online]. Available from: http://www.info.gov.za/view/DownloadFileAction?id=135748. [Accessed: 14 March 2013].

Government of SA. (2012). *Ministerial media briefing on the Further Education and Training (FET) Colleges: Turnaround Strategy*. [Online]. Cape Town: http://www.info.gov.za/speech/DynamicAction?pageid=461&sid=32298&tid=90610: Government of South Africa. Available from: http://www.info.gov.za/speech/DynamicAction?pageid=461&sid=32298&tid=90610. [Accessed: 20 June 2013].

Graham, L., & De Lannoy, A. (2017). What South Africa can do about youth unemployment in the short run. *Sowetan Live*. [Online]. Available from http://www.sowetanlive.co.za/news/2017/02/14/what-south-africa-can-do-about-youth-unemployment-in-the-short-run. [Accessed: 31 August 2017].

Grant, M.J. & Booth, A. (2009). A typology of reviews: an amalysis of 14 review types and associated methodologies. *Health Information and Libraries Journal*. 26. pp. 91-108.

Greene, J.C. (2006). Toward a methodology of mixed methods social inquiry. *Research in the Schools*. 13. pp. 93-98.

Gregor, S. (2006). The Nature of Theory in Information Systems. *MIS Quarterly*. 30 (3). pp. 611-642.

Gregor, S. & Hevner, A.R. (2013). Positioning and Presenting Design Science Research for Maximun Impact. *MIS Quarterly*. 37 (2). pp. 337-355.

Grindley, K. (1991). *Managing IT at board level: The hidden agenda exposed.* London: Pitman Publishing.

Hamilton, S. & Ives, B. (1983). The Journal Communication Systems for MIS Research. *Data Base Winter 1983*. 14. pp. 3-14.

Hart, C. (1998). *Doing a literature review: Releasing the social science research imagination*. London, UK: SAGE Publications Ltd.

Herselman, M.E. & Botha, A. (2016). *Strategies, Approaches and Experiences: Towards building a South African Digital Health Innovation Ecosystem*. CSIR Meraka.

Hevner, A., & Chatterjee, S. (2010). Design science research in information systems. In *Design research in information systems* (pp. 9-22). Springer US.

Hevner, A.R. (2007). A Three Cycle View of Design Science Research. *Scandinavian Journal of Information Systems*. 19 (2). pp. 87-92.

Hevner, A.R., March, S.T., Park, J. & Ram, S. (2004). Design science in information systems research. *MIS Quarterly*. 28 (1). pp. 75-105.

Houghton Mifflin Company (2009). *The American Heritage® Dictionary of the English Language*. [Online]. https://www.ahdictionary.com/: Fourth Edition copyright ©2000, Houghton Mifflin Company. Available from: https://www.ahdictionary.com/. [Accessed: 12 August 2017].

Howcroft, D., & Trauth, E. (2004). The choice of critical information systems research. *Information Systems Research*, pp. 195-211.

Huck, S.W. (2008). *Reading statistics and research*. Boston, Massachusetts: Pearson Education Inc.

Ifinedo, P., Rapp, B., Ifinedo, A. & Sundberg, K. (2010). Relationships among ERP post-implementation success constructs: An analysis at the organizational level. *Computers in Human Behavior*. 26. pp. 1136-1148.

Iivari, J. (1983). *Contributions to the Theoretical Foundations of Systemeering Research and the PIOCO Model*. Acta Universitatis Ouluensis. Oulu, Finland: Institute of Data Processing Science: Distributed by Oulu University Library.

Iivari, J. (2007). A Paradigmatic Analysis of Information Systems As a Design Science. *Scandinavian Journal of Information Systems*. [Online]. 19 (2, Article 5). Available from: http://aisel.aisnet.org/sjis/vol19/iss2/5. [Accessed: 12 August 2017].

Interviewee 1. (2015). *Management Information Systems at public TVET Colleges: Interview with DHET manager*.

Interviewee 2. (2015). *Management Information Systems at public TVET Colleges: Interview with Deputy Principal Academic Affairs at College 3*.

Interviewee 3. (2015). *Management Information Systems at public TVET Colleges: Interview with Management Information System Specialist at College 3*.

Interviewee 4 (2015). *Management Information Systems at public TVET Colleges: Interview with Curriculum Manager at College 2*.

Interviewee 5 (2015). *Management Information Systems at public TVET Colleges: Interview with MIS Officer at College 1*.

IPRR (2009). Investigation Methodology Evaluations. Investigation Process Research Resource (IPRR). Available from: http://www.iprr.org/evals/evalsintro.html#whatis. [Accessed: 6 March 2018].

Irani, Z. & Love, P.E.D. (2008a). Information systems evaluation: A crisis of understanding. In: Z. Irani & P. E. D. Love (eds.). *Evaluating information systems: public and private sector*. Hungary: Butterworth-Heinemann.

Irani, Z. & Love, P.E.D. (2008b). Preface. In: Z. Irani & P. E. D. Love (eds.). *Evaluating information systems: public and private sector*. Hungary: Hungary: Butterworth-Heinemann.

Irny, S.I. & Rose, A.A. (2005). Designing a Strategic Information Systems Planning Methodology for Malaysian Institutes of Higher Learning (isp-ipta). *Issues in Information Systems*. 6 (1). pp. 325-331.

iTS holdings (2016). *iTS holdings*. [Online]. Available from: http://www.itweb.co.za/office/its/profile.htm. [Accessed: 30 November 2016].

Ives, B., Olson, M.H. & Baroudi, J.J. (1983). The measurement of user information satisfaction. *Communications of the ACM*. 26 (10). pp. 785-793.

Jiang, J.J., Klein, G. & Carr, C.L. (2002). Measuring Information System Service Quality: SERVQUAL from the Other Side. *MIS Quarterly*. 26 (2). pp. 145-166.

Johnson, R.B., Onwuegbuzie, A.J. & Turner, L.A. (2007). Toward a Definition of mixed methods research. *Journal of Mixed Methods Research*. 1. pp. 112-133.

Joubert, (2015). *TVET Colleges: 2015 Strategic and Operational Planning*. [Online]. Available from: www.dhet.gov.za. [Accessed: 11 October 2016].

Kaplowitz, M.D., Hadlock, T.D. & Levine, R. (2004). A Comparison of Web and Mail Survey Response Rates, *Public Opinion Quarterly*. 68(1). pp. 94-101. https://doi.org/10.1093/poq/nfh006.

Kendall, M. (1938). A New Measure of Rank Correlation. *Biometrika*. 30 (1-2). pp. 81-89.

Kinash, S. (2006). *Paradigms, methodology & methods*. [Online]. Bond University. Available from: http://ucmbc.bond.edu.au/ucm_bc/groups/public/@pub-tls-gen/documents/genericwebdocument/bd3_012336.pdf. [Accessed: 12 August 2017].

King, J.A. (2014). *An update on the latest evaluation theories and models*. [Online]. Available from: http://www.cehd.umn.edu/OLPD/MESI/spring/2015/King-EvalTheoryUpdate.pdf. [Accessed: 11 April 2016].

Klastorin, T.D. (1983). Cluster Analysis Results. *Journal of Marketing Research*. 20 (1). pp. 92-98.

Klopper, R., Lubbe, S. & Rugbeer, H. (2007). The matrix method of literature review. *Alternation*. 14 (1). pp. 1-17.

Korporowicz, L. (1997). *Ewaluacja w edukacji*. Warszawa: Oficyna Naukowa.

Kraak, A., Paterson, A. & Boka, K. (Eds.) (2016). *Change management in TVET Colleges: Lessons learnt from the field of practice*. First. [Online]. Cape Town: JET Education Services, African Minds. Available from: www.jet.org.za. [Accessed: 23 August 2016].

Kriebel, C.H. (1970). The evaluation of management information systems. In: *MIS Copenhagen 70*. [Online]. 1970, Elsinore, Denmark: Danish IFIP Administrative Data Processing Group (DIAG), pp. 1-23. Available from: http://www.dtic.mil/dtic/tr/fulltext/u2/723083.pdf. [Accessed: 26 April 2016].

Kruss, G., Visser, M.M., Aphane, M. & Haupt, G. (2011). *Academic interaction with external social partners: Investigating the contribution of universities to economic and social development*. Pretoria, South Africa: Human Sciences Research Council (HSRC).

Kuechler, B. & Vaishnavi, V. (2011). Promoting Relevance in IS Research: An Informing System for Design Science Research. *Informing Science: The International Journal of an Emerging Transdiscipline*. 14. pp. 125-138.

Kuhn, T. S. (1970). The structure of scientific revolutions, International Encyclopedia of Unified Science, vol. 2, no. 2.

Lærum, H., Karlsen, T.H. & Faxvaag, A. (2004). Use of and attitudes to a hospital information system by medical secretaries, nurses and physicians deprived of the paper-based medical record: a case report. *BMC Medical Informatics and Decision Making*. [Online]. 4 (18). pp. 1-10. Available from: http://www.biomedcentral.com/1472-6947/4/18. [Accessed: 12 August 2017].

Landis, J.R. & Koch, G.G. (1977). The measurement of observer agreement for categorical data. *Biometrics*. 33. pp. 159-174.

Landrum, H., Prybutok, V., Zhang, X. & Peak, D. (2009). Measuring IS System Service Quality with SERVQUAL: Users' Perceptions of Relative Importance of the Five SERVPERF Dimensions. *The International Journal of an Emerging Transdiscipline*. 12. pp. 17-35.

LaPiere, R.T. (1934a). Attitudes vs. Actions. *Social Forces*. 13. pp. 230-237.

LaPiere, R.T. (1934b). Propaganda and education: the need for a quantitative distinction. *Sociology and Social Research*. 20. pp. 18-26.

Lazar, J., Feng, J.H. & Hochheiser, H. (2010). *Research methods in human-computer interaction*. West Sussex, UK: John Wiley & Sons Ltd.

Leavitt, H.J. (1965). *Applied organizational change in industry: structural, technological and humanistic approaches*. Handbook of Organizations. J. G. March (Ed.). Chicago: Rand-McNally.

Lee, D., Rhee, Y. & Dunham, R.B. (2009). The role of organizational and individual characteristics in technology acceptance. *International Journal of Human-Computer Interaction*. 25. pp. 623-646.

Levy, Y. & Ellis, T.J. (2006). A Systems Approach to Conduct an Effective Literature Review in Support of Information Systems Research. *Informing Science Journal*. 9. pp. 181-212.

Lucas, H.C. (1983). A Multidisciplinary Approach to Information Systems Research. In: *Working paper Series CRIS #61, GBA #83-108(CR)*. 1983, New York University: Center for Digital Economy Research. Stern School of Business, pp. 1-14.

Ludbrook, J. (2010). Confidence in Altman–Bland plots: A critical review of the method of differences. *Clinical and Experimental Pharmacology and Physiology*. 37 (2). pp. 143-149.

Lyytinen, K. & Hirschheim, R. (1988). Information systems failures—a survey and classification of the empirical literature. In: *Oxford surveys in Information Technology*. New York: Oxford University Press, Inc., pp. 257-309.

Manfreda, K. L., Bosnjak, M., Berzelak, J., Haas, I., Vehovar, V., & Berzelak, N. (2008). Web surveys versus other survey modes: A meta-analysis comparing response rates. *Journal of the Market Research Society*. 50 (1), pp. 79-104.

Mannie, A., Van Niekerk, H.J., & Adendorff, C.M. (2013). Significant factors for enabling knowledge sharing between government agencies within South Africa. *South African Journal of Information Management*. 15 (2), Art. #569, 8 pages. Available from: http://dx.doi. org/10.4102/sajim.v15i2.569. [Accessed: 18 March 2016].

March, S.T. & Smith, G. (1995). Design and natural science research on information technology. *Decision Support Systems*. 15 (4). pp. 251-266.

Mardiana, S., Tjakraatmadja, J.H. & Aprianingsih, A. (2015). *DeLone–McLean Information System Success Model Revisited: The Separation of Intention to Use - Use and the Integration of Technology Acceptance Models*. In: 2015, Universiti Teknologi Malaysia, Kuala Lumpur, Malaysia: International Journal of Economics and Financial Issues, pp. 172-182.

Mark, M. (2005). The evaluation exchange: Evaluation theory or What are evaluation methods for? *Harvard Family Research Project*. [Online]. 11 (2). pp. 1-20. Available from: http://www.hfrp.org/var/hfrp/storage/original/application/d6517d4c8da2c9f1fb3dffe3e8b68ce4.pdf. [Accessed: 23 November 2015].

Marock, C., Hazell, E. & Akoobhai, B. (2016). What will it take to turn TVET Colleges around? Evaluation of a large-scale college improvement programme. In: *Change Management in TVET Colleges: Lessons learnt from the field of practice*. Pretoria, South Africa: JET Education Services, African Minds, pp. 103-119.

Mason, R.O. (1978). Measuring Information Output: A Communication Systems Approach. *Information and Management*. 1 (4). pp. 219-234.

Mastin, L. (2008). *Th Basics of Philosophy: A huge subject broken down into manageable chunks*. [Online]. Available from: http://www.philosophybasics.com/movements_structuralism.html. [Accessed: 1 February 2016].

McConnell, S. (1996). *Rapid Development. Taming Wild Software Schedules*. D. J. Clark & J. Litewka (Eds.). Redmond, Washington: Microsoft Press.

McGill, T., Hobbs, V. & Klobas, J. (2003). User-developed applications and information systems success: a test of DeLone and McLean's model. *Information Resources Management Journal*. 16 (1). pp. 24-45.

McGregor, S.L.T. & Murnane, J.A. (2010). Paradigm, methodology and method: Intellectual integrity in consumer scholarship. *International Journal of Consumer Studies*. 34 (4). pp. 419-427.

Mcintire, J. (2010). *Audit, Plan, Build, Grow: A Methodology for Content Strategy [Online]*. [Online]. Available from: http://predicate.io/media/presentation/audit-plan-build-grow-a-methodology-for-content-strategy/#sthash.FAeOmQyX.dpuf. [Accessed: 19 July 2013].

McKenzie, J.F., Wood, M.L., Clark, J.K., Kotecki, J.E. & Brey, R.A. (1999). Establishing content validity: Using qualitative and quantitative steps. *American Journal of Health Behavior*. 23 (4). pp. 311-318.

McNall, M. (2009). *Evaluation Theory: The Enduring Issues*. [Online]. Available from: http://cerc.msu.edu/documents/Evaluation_Theory_2009_10_30.pdf. [Accessed: 11 April 2016].

Menon, S. (2017). SA's unemployment rate hits a 13-year high. Times Live. [Online]. Available from: https://www.timeslive.co.za/news/south-africa/2017-06-01-sas-unemployment-rate-hits-a-13-year-high/. [Accessed: 10 September 2017].

Microsoft (2010). *Microsoft Excel*. [Online]. Microsoft. Available from: https://www.microsoft.com/en-za/download/office.aspx.

Miles, M.B., Huberman, A.M. & Saldana, J. (2014). *Qualitative Data Analysis: A Methods Sourcebook*. Thousand Oakes, California: SAGE Publications, Inc.

Mingers, J. (2001). Combining IS Research Methods: Towards a Pluralist Methodology. *Information Systems Research*. 12 (3). pp. 240-259.

Mingers, J. (2003a). A classification of the philosophical assumptions of management science methods. *Journal of the Operational Research Society*. 54. pp. 559-570.

Mingers, J. (2003b). The pausity of multimethod research: a review of the information systems literature. *Information Systems Journal*. 13. pp. 233-249.

Mingers, J., Mutch, A. & Willcocks, L. (2013). Critical Realism in Information Systems research. *MIS Quarterly*. 37 (3). pp. 795-802.

Mouton, J. (2001). *How to Succeed in Your Master's and Doctoral Studies: A South African Guide and Resource Book*. Pretoria: Van Schaik Publishers.

Mudzana, T., & Maharaj, M. (2015). Measuring the success of business-intelligence systems in South Africa: An empirical investigation applying the DeLone and McLean Model. *South African Journal of Information Management*. 17(1), Art. #646, 7 pages. Available from: http://www.sajim.co.za/index.php/SAJIM/article/view/646. [Accessed: 21 March 2016].

Muzamil (2012). *Cluster Analysis In SPSS (Hierarchical, Non-hierarchical & Two-step)*. [Online]. Available from: https://www.youtube.com/watch?v=eW9KnSRDyTk. [Accessed: 19 March 2015].

Myers, B.L., Kappelman, L.A. & Prybutok, V.R. (1997). A comprehensive model for assessing the quality and productivity of the information systems function: Toward a theory for information systems assessment. *Information Resources Management Journal*. 10 (1). pp. 6-25.

Myers, M.D. & Klein, H.K. (2011). A Set of Principles for Conducting Critical Research in Information Systems. *MIS Quarterly*. 35 (1). pp. 17-36.

Nelson, R.R. (2007). IT Project Management: Infamous Failures, Classic Mistakes, and Best Practices. *MIS Quarterly Executive*. 6 (2). pp. 67-78.

NPC (2011). *National Development Plan: Vision for 2030*. Pretoria: National Planning Commission, Government.

NPC (2013). *Our Future - make it work: National Development Plan 2030, Executive Summary*. [Online]. Pretoria, South Africa: The Precidency: National Planning Commission. Available from: http://www.gov.za/sites/www.gov.za/files/Executive%20Summary-NDP%202030%20-%20Our%20future%20-%20make%20it%20work.pdf. [Accessed: 12 August 2017].

Nunamaker, J., Chen, M. & Purdin, T.D.M. (1991). Systems development in information systems research. *Journal of Management Information Systems*. 7 (3). pp. 89-106.

Nzimande, B. (2014). *Swiss Chamber of Commerce partners with the Department of Higher Education and Training: Speech by South Africa's Minister of Higher Education and Training*. [Online]. Available from: http://www.fetcolleges.co.za/. [Accessed: 12 October 2016].

Nzimande, B. (2017). DHET: Blade Nzimande: Address by Minister of Higher Education and Training, on opportunities for Matric Class 2016 in Post-School Education and Training, Hatfield, Pretoria (12/01/2017). [Online]. Available from http://www.engineeringnews.co.za/article/dhet-blade-nzimande-address-by-minister-of-highereducation-and-training-on-opportunities-for-matric-class-2016-in-post-school-education-andtraining-hatfield-pretoria-12012017-2017-01-12-1. [Accessed on 17 September 2017].

Oates, B.J. (2006). *Researching Information Systems and Computing*. London: SAGE Publication Ltd.

OECD (2010). *Glossary of Key Terms in Evaluation and Results Based Management*. [Online]. Organisation. Available from: https://www.oecd.org/dac/evaluation/2754804.pdf. [Accessed: 18 January 2017].

Olivier, M.S. (2004). *Information technology research: A practical guide for computer science and informatics*. Pretoria, South Africa: Van Schaik.

Ong, C.S., Day, M.Y. & Hsu, W.L. (2009). The measurement of user satisfaction with question answering systems. *Information and Management*. 46. pp. 397-403.

Orlikowski, W. J., & Baroudi, J. J. (1991). Studying information technology in organizations: Research approaches and assumptions. *Information systems research*, 2(1), pp. 1-28.

Orlikowski, W.J. & Iacono, C.S. (2001). Research Commentary: Desperately Seeking the 'IT' in IT Research—A Call to Theorizing the IT Artifact. *Information Systems Research*. [Online]. 12 (2). pp. 121-134. Available from: http://www.nyu.edu/projects/nissenbaum/papers/Orlikowski.pdf. [Accessed: 8 January 2016].

Paterson, A. (2005). Information systems and institutional mergers in South African Higher Education. *South African Journal of Higher Education*. 19 (1). pp. 113-128.

Paterson, A. (2016). Introduction: Perspectives on programmes, projects and policies in the TVET Colleges. In: A. Kraak, A. Paterson, & K. Boka (Eds.). *Change Management in TVET Colleges: Lessons learnt from the field of practice*. Cape Town: African Minds, 148 pages.

Patton, M.Q. (1982). *Practical Evaluation*. Beverly Hills, CA: SAGE Publication Ltd.

Patton, M.Q. (2010). *Utilization-Focused Evaluation with Michael Quinn Patton*. [Online]. Available from: https://www.researchgate.net/profile/Michael_Patton4/publication/225981411_Utilization-focused_Evaluation/links/54f4678e0cf299c8d9e74712.pdf. [Accessed: 13 April 2016].

Paulk, M.C., Weber, C.V., Curtis, B. & Chrissis, M.B. (1993). *Capability Maturity Model for Software (Version 1.1)*. Pittsburgh, PA: Software Engineering Institute, Carnegie Mellon University. CMU/SEI-93-TR-024 ESC-TR-93-177.

Pawson, R. (2013). *Realist Evaluation 'taster' - short introduction*. [Online]. Available from: https://www.youtube.com/watch?v=xJSehOBa75I. [Accessed: 11 April 2016].

Pearson, K. (1900). On the criterion that a given system of deviations from the probable in the case of a correlated system of variables is such that it can be reasonably supposed to have arisen from random sampling. *Philosophical Magazine Series*. 5 (50). pp. 157-175.

Pearson, K. (1901). On Lines and Planes of Closest Fit to Systems of Points in Space. *Philosophical Magazine*. 2 (11). pp. 559-572.

Peffers, K., Tuunanen, T., Gengler, C.E., Rossi, M., Hui, W., Virtanen, V., & Bragge, J. (2006, February). The design science research process: a model for producing and presenting information systems research. In *Proceedings of the first international conference on design science research in information systems and technology (DESRIST 2006)* (pp. 83-106). sn.

Peffers, K., Tuunanen, T., Rothenberger, M.A., & Chatterjee, S. (Winter of 2007/8). A design science research methodology for information systems research. *Journal of management information systems*, 24(3), pp. 45-77.

Petter, S., DeLone, W. & McLean, E.R. (2008). Measuring information systems success: models, dimensions, measures, and interrelationships. *European Journal of Information Systems*. 17. pp. 236-263.

Petter, S., DeLone, W. & McLean, E.R. (2013). Information Systems Success: The Quest for the Independent Variables. *Journal of Management Information Systems*. 29 (4). pp. 7-62.

Pietersen, J. & Damianov, G. (2001). *Guide to practical statistics*. Pretoria, South Africa: HSRC/RGN.

Piirainen, K.A. & Gonzalez, R.A. (2013). *Seeking Constructive Synergy: Design Science and the Constructive Research Approach*. In: 2013, Berlin Heidelberg: Springer-Verlag, pp. 59-72.

Pitt, L.F., Watson, R.T. & Kavan, C.B. (1995). Service Quality: A Measure of Information Systems Effectiveness. *MIS Quarterly*. 19 (2). pp. 173-187.

Platiša, G. & Balaban, N. (2009). Methodological Approaches to Evaluation of Information System Functionality Performances and Importance of Successfulness Factors Analysis. *Management Information Systems*. 4 (2). pp. 11-17.

Pote, N. (2014). Current challenges with examinations in the TVET System. In: *Together forging a vibrant Technical and Vocational Education and Training system in South Africa*. 2014, Pretoria, South Africa: Department of Higher Education and Training.

Pretorius, M.C. (2012). *A Methodology to Institutionalise User Experience in a South African Provincial Government*. Port Elizabeth: Nelson Mandela Metropolitan University.

Pretorius, M.C. & Calitz, A.P. (2014). A methodology to institutionalise user experience in provincial government. *South African Computer Journal*. (55). pp. 25-39.

Punj, G. & Stewart, D.W. (1983). Cluster Analysis in Marketing Research: Review and Suggestions for Application. *Journal of Marketing Research*. 20 (2). pp. 134-148.

Rai, A., Lang, S.S. & Welker, R.B. (2002). Assessing the validity of IS success models: An empirical test and theoretical analysis. *Information Systems Research*. 13. pp. 50-69.

Reddy, V., Bhorat, H., Powell, M., Visser, M. & Arends, F. (2016). *Skills Supply and Demand in South Africa*. LMIP Publication. Human Sciences Research Council.

Remenyi, D. (2002). *Criteria to evaluate a website*. [Online]. England: Management Centre International Limited. Available from: http://www.mcil.co.uk/review/7-10-criteria.htm. [Accessed: 19 March 2015].

Republic of South Africa (2013). *No. 4 of 2013: Protection of Personal Information Act, 2013. Government Gazette, Vol. 581, No. 37067, 26 November 2013. The Presidency. Pretoria, South Africa*.

Rhoads, V. (2008). *Web Maturity Models*. [Online]. Business, Technology. Available from: http://www.slideshare.net/vtrhoads/web-maturity-models. [Accessed: 19 March 2015].

Rittel, H. W., & Webber, M. M. (1973). Dilemmas in a general theory of planning. *Policy sciences*, 4(2), pp. 155-169.

Rittel, H.J. & Webber, M.M. (1984). Planning Problems Are Wicked Problems. In: N. Cross (Ed.). *Developments in Design Methodology*. New York: John Wiley & Sons Ltd.

Robson, W. (1997). *Strategic Management and Information Systems: An Integrated Approach*. London: Pitman Publishing.

Rubinoff, R. (2004). Quantify User Experience. *Design & UX*. [Online]. Available from: http://www.sitepoint.com/quantify-user-experience/. [Accessed: 12 June 2015].

Ruegg, R. (2007). *Overview of Evaluation Methods for R&D Programs: A Directory of Evaluation Methods Relevant to Technology Development Programs*. [Online]. Available from: https://www1.eere.energy.gov/analysis/pdfs/evaluation_methods_r_and_d.pdf. [Accessed: 6 April 2016].

Sabherwal, R., Jeyaraj, A. & Chowa, C. (2006). Information system success: Individual and organizational determinants. *Management Science*. 52 (12). pp. 1849-1864.

Sadiq, M.M., (2012). Cluster analysis in SPSS (hierarchical, non-hierarchical & two-step). Available from: https://www.youtube.com/watch?v=eW9KnSRDyTk. [Accessed: 19 March 2015].

Sarstedt, M. & Mooi, E. (2014). *A Concise Guide to Market Research: The Process, Data, and Methods Using IBM SPSS Statistics*. [Online]. Springer-Verlag Berlin Heidelberg. Available from: http://www.guide-market-research.com/. [Accessed: 12 August 2017].

Sauer, C. (1993). *Why information systems fail: a case study approach*. Alfred Waller Ltd., Publishers.

Saunders, M., Lewis, P. & Thornhill, A. (2009). *Research methods for business students*. Fifth edition. Harlow, Essex, England: Pearson Education Limited.

Scotland, J. (2012). Exploring the Philosophical Underpinnings of Research: Relating Ontology and Episemology to the Methodology and Methods of the Scientific, Interpretive, and Critical Research Paradigms. *English Language Teaching*. [Online]. 5 (9). pp. 9-16. Available from: http://dx.doi.org/10.5539/elt.v5n9p9. [Accessed: 12 August 2017].

Seawright, J. & Gerring, J. (2008). Case Selection Techniques in Case Study Research: A Menu of Qualitative and Quantitative Options. *Political Research Quarterly*. 61 (2). pp. 294-308.

Seddon, P.B. (1997). A Respecification and Extension of the DeLone and McLean Model of IS Success. *Information Systems Research*. 8 (3). pp. 240-253.

Seddon, P.B. & Kiew, M.Y. (1996). A Partial Test and Development of DeLone and McLean's Model of IS Success. *Australian Journal of Information Systems*. 4 (1). pp. 90-109.

Seddon, P. & Scheepers, R. (2012). Towards the improved treatment of generalization of knowledge claims in IS research: Drawing general conclusions from samples. *European Journal of Information Systems*. 21. pp. 6-21. https://doi.org/10.1057/ejis.2011.9.

Sedera, D., Gable, G.G. & Chan, T. (2004). A factor and structural equation analysis of the Enterprise Systems Success Measurement Model. In: *AMCIS 2004 Proceedings*. [Online]. 2004, New York, USA: AIS Electronic Library (AISeL). Available from: http://aisel.aisnet.org/amcis2004/94. [Accessed: 12 August 2017].

Shadish, W.R., Cook, T.D. & Leviton, L.C. (1991). *Foundations of Program Evaluation: Theories of Practice*. [Online]. SAGE Publication Ltd. Available from: http://www.amazon.com/Foundations-Program-Evaluation-Theories-Practice/dp/0803953011. [Accessed: 11 April 2016].

Shannon, C.E. & Weaver, W. (1949). *The Mathematical Theory of Communication*. Urbana, IL: University of Illinois Press.

Shapiro, S.S. & Wilk, M.B. (1965). An analysis of variance test for normality (complete samples). *Biometrika*. 52 (3-4). pp. 591-611.

Simon, H.A. (1988). The Science of Design: Creating the Artificial. *Design Issues*. [Online]. 4(1 & 2). pp. 67-82. Available from: http://www.jstor.org/stable/1511391. [Accessed: 12 August 2017].

Simon, H.A. (1996). *The Sciences of the Artificial*. 3rd Ed. [Online]. London, England: The MIT Press, Cambridge, Massachusetts. Available from: https://books.google.co.za/books?hl=en&lr=&id=k5Sr0nFw7psC&oi=fnd&pg=PR9&dq=Simon,+H.+(1996)+The+Sciences+of+Artificial,+3rd+edn.,+MIT+Press,+Cambridge,+MA.&ots=-v0HiGJOKt&sig=26ugtbfaDqM_14dBuPSglKkgw1k#v=onepage&q&f=false. [Accessed: 12 August 2017].

SPSS an IBM Company (2017). *IBM SPSS Statistics Family*. [Online]. United States of America: IBM. Available from: https://www.ibm.com/analytics/us/en/technology/spss/#what-is-spss. [Accessed: 12 August 2017].

Stake, R. (1994). *Case studies. In: Denzin, N., Lincoln, Y. (Eds.), Handbook of Qualitative Research*. SAGE Publication Ltd. London.

StatPac (2014). *Survey Sampling Methods*. [Online]. StatPac. Available from: https://www.statpac.com/surveys/sampling.htm. [Accessed: 11 April 2015].

Stats SA. (2016). Vulnerable Groups Indicator Report. Report No. 03-19-02(2016). Statistics South Africa. 112 pages.

Stats SA. (2017). Quarterly Labour Force Survey. Quarter 2: 2017. Statistical release P0211. Statistics South Africa.

Summers, S. (1991). Selecting the sample for a research study. *Journal of Post Anesthesia Nursing*. [Online]. 6 (5). pp. 355-363. Available from: http://www.ncbi.nlm.nih.gov/pubmed/1833537. [Accessed: 10 April 2017].

Sweeney, D. & Pritchard, M. (2010). *Planning your Evaluation: Types of evaluation*. [Online]. Available from: http://evaluationtoolbox.net.au/index.php?option=com_content&view=article&id=15&Itemid=19. [Accessed: 6 April 2016].

Tomhave, B.L. (2005). *Alphabet Soup: Making Sense of Models, Frameworks, and Methodologies*. [Online]. Available from: http://www.secureconsulting.net/Papers/Alphabet_Soup.pdf. [Accessed: 12 July 2011].

Trochim, W.M. (2006). *The Research Methods Knowledge Base, 2nd Edition*. [Online]. Research Methods: Knowledge Base. Available from: http://www.socialresearchmethods.net/kb/intreval.php. [Accessed: 2 April 2015].

Tullis, T. & Albert, W. (2013). *Measuring the User Experience - Collecting, Analyzing, and Presenting Usability Metrics, 2nd Edition*. Morgan Kauffman, ISBN: 0124157815, 320 pages.

TVET Colleges South Africa (2015). *Public TVET Colleges: Overview*. [Online]. The official website for the DHET TVET Colleges. Available from: http://www.fetcolleges.co.za/. [Accessed: 25 March 2015].

UBC (2015). *Web Maturity Model - Information Technology*. [Online]. Available from: www.it.ubc.ca. [Accessed: 5 December 2015].

Uebersax, J.S. (1987). Diversity of decision making models and the measurement of interrater agreement. *Psychological Bulletin*. 101. pp. 140-146.

UNCTAD & TNSO, (2008). *United Nations Conference on Trade and Development. Measuring the impact of ICT use in business: the case of manufacturing in Thailand. Prepared jointly by the UNCTAD secretariat and the Thailand National Statistical Office (TNSO)*. New York and Geneva: United Nations. Available from:

http://unctad.org/en/docs/sdteecb20073_en.pdf. [Accessed: 12 November 2016].

Vaishnavi, V. & Kuechler, W. (2015a). *Design Science Research in Information Systems*. [Online]. Available from: http://www.desrist.org/design-research-in-information-systems/, Last updated on 15 November 2015. [Accessed: 7 January 2016].

Vaishnavi, V.K., & Kuechler, W. (2015b). *Design science research methods and patterns: innovating information and communication technology*. Crc Press.

Venable, J. (2006). A framework for design science research activities. In *Emerging Trends and Challenges in Information Technology Management: Proceedings of the 2006 Information Resource Management Association Conference* (pp. 184-187). Idea Group Publishing.

Venable, J.R. (2008). *Design Science Research Post Hevner et al: Criteria, Standards, Guidelines, and Expectations*. [Online]. Available from: http://www.researchgate.net/. [Accessed: 11 January 2016].

Venable, J.R. & Travis, J. (1999). Using a Group Support System for the Distributed Application of Soft Systems Methodology. In: *Proceedings of the 10th Australasian Conference on Information Systems*. 1999, Wellington, New Zealand, pp. 1105-1117.

Venkatesh, V. & Bala, H. (2008). Technology Acceptance Model 3 and a Research Agenda on Interventions. *Decision Sciences*. 39 (2). pp. 273-315.

Venkatesh, V. & Davis, F.D. (2000). A Theoretical Extension of the Technology Acceptance Model: Four Longitudinal Field Studies. *Management Science*. 46 (2). pp. 186-204.

Venkatesh, V., Morris, M.G., Davis, F.D. & Davis, G.B. (2003). User Acceptance of Information Technology: Toward a Unified View. *MIS Quarterly*. 27. pp. 425-478.

Venkatesh, V., Thong, J.Y.L. & Xu, X. (2012). Consumer acceptance and use of Information Technology: Extending the Unified Theory of Acceptance and Use of Technology. *MIS Quarterly*. [Online]. 36 (1). pp. 157-178. Available from: http://aisel.aisnet.org/misq/vol36/iss1/13/. [Accessed: 11 January 2016].

Visser, M.M. (2012). *Towards developing an evaluation tool for business management information systems' success at public Further Education and Training (FET) Colleges in South Africa*. Master of Science. Pretoria: University of South Africa (UNISA).

Visser, M.M., van Biljon, J.A. & Herselman, M.E. (2012). Modeling Management Information Systems' Success: a study in the domain of Further

Education and Training. In: *Conference of the South African Institute of Computer Scientists and Information Technologists: Contemplate Connect Collaborate*. 2012, Pretoria, South Africa: ACM.

Visser, M.M., van Biljon, J.A. & Herselman, M.E. (2013). Evaluation of management information systems: A study at a Further Education and Training College. *South African Journal of Information Management*. [Online]. 15 (1). Art. #531, 8 pages. Available from: http://dx.doi.org/10.4102/ sajim.15i1.531. [Accessed: 11 March 2016].

Visser, M.M., van Biljon, J.A. & Herselman, M. (2017). Evidence-based case selection: An innovative knowledge management method to cluster public Technical and Vocational and Education and Training Colleges in South Africa. *South African Journal of Information Management*. 19 (1). pp. 1-13.

Weber, R. (2004). The Rhetoric of Positivism vs. Interpretivism: A Personal View. *MIS Quarterly*. 28 (1). pp. iii-xii.

Weber, R. (2012). Evaluating and Developing Theories in the Information Systems Discipline. *Journal of the Association for Information Systems,* (13)1, pp. 2-30.

WebFinance (2015). *BusinessDictionary.com*. [Online]. Available from: http://www.businessdictionary.com/definition/methodology.html. [Accessed: 12 August 2017].

Webster, J. & Watson, R.T. (2002). Analyzing the past to prepare for the future: Writing a literature review. *MIS Quarterly*. 26 (2). pp. xiii-xxiii.

Webster, M. (2015). Merriam-Webster Online Dictionary. *Merriam-Webster Online Dictionary*. [Online]. Available from: http://www.merriam-webster.com/dictionary/philosophy. [Accessed: 12 August 2017].

Weiss, H.B. (2005). The Evaluation Exchange. A periodical on emerging strategies in evaluating child and family services. *Harvard Family Research Project*. [Online]. 11 (2). pp. 1-20. Available from: http://www.hfrp.org/var/hfrp/storage/original/application/d6517d4c8da2c9f1fb3dffe3e8b68ce4.pdf. [Accessed: 23 November 2015].

Wellington, J., Bathmaker, A., Hunt, C., Mcculloch, G. & Sikes, P. (2005). *Succeeding with your Doctorate*. London: Thousand Oakes, California, and New Delhi: SAGE Publications, Inc.

Wells, H. (2012). How effective are project management methodologies-an explorative evaluation of their benefits in practice. *Project Management Journal*.

Wijnberg, C. (2013). *The state of youth unemployment in South Africa*. [Online]. Available from: http://www.youthvillage.co.za/The%20state%20of%20youth%20unemplo yment%20in%20South%20Africa%20by%20Catherine%20Wijnberg.html. [Accessed: 22 September 2013].

Williams, M.D., Dwivedi, Y.K., Lal, B. & Schwarz, A. (2009). Contemporary trends and issues in IT adoption and diffusion research. *Journal of Information and Technology*. 24. pp. 1-10.

Williams, P. (2013). *Overcoming youth unemployment together*. [Online]. Pretoria: SAnews.gov.za. Available from: http://www.sanews.gov.za/south-africa/overcoming-youth-unemployment-together. [Accessed: 22 September 2013].

Williamson, G.R. (2003). Misrepresenting random sampling? A systematic review of research papers in the Journal of Advanced Nursing. *Journal of Advanced Nursing*. 44 (3). pp. 278-288.

Wixom, B.H. & Todd, P.A. (2005). A theoretical integration of user satisfaction and technology acceptance. *Information Systems Research*. 16 (1). pp. 85-102.

Yin, R.K. (2003). *Case study research: design and methods*. California: SAGE Publication Ltd.

Ziemba, E., & Papaj, T. (2013). A Pragmatic Approach to the E-Government Maturity in Poland - Implementation and Usage of SEKAP. Academic Conferences International Limited, June 2013, Varese, Italy, pp. 560-570.

Zotero (2015). *Zotero Referencing Tool*. [Online]. Roy Rosenzweig Center for History and New Media, funded by the Andrew W. Mellon Foundation, the Institute of Museum and Library Services, and the Alfred P. Sloan Foundation. Available from: https://www.zotero.org/. [Accessed: 10 November 2015].

APPENDIX A: Ethical Clearance

UNISA college of science, engineering and technology

Dear Mrs Margaretha Maria Visser (34747788)

Date: 2015-01-166

Application number: 183/MMV/2014

REQUEST FOR ETHICAL CLEARANCE: (A methodology for the evaluation of Management Information Systems at public Technical and Vocational Education and Training Colleges in South Africa)

The College of Science, Engineering and Technology's (CSET) Research and Ethics Committee has considered the relevant parts of the studies relating to the abovementioned research project and research methodology and is pleased to inform you that ethical clearance is granted for your research study as set out in your proposal and application for ethical clearance.

Therefore, involved parties may also consider ethics approval as granted. However, the permission granted must not be misconstrued as constituting an instruction from the CSET Executive or the CSET CRIC that sampled interviewees (if applicable) are compelled to take part in the research project. All interviewees retain their individual right to decide whether to participate or not.

We trust that the research will be undertaken in a manner that is respectful of the rights and integrity of those who volunteer to participate, as stipulated in the UNISA Research Ethics policy. The policy can be found at the following URL:
http://cm.unisa.ac.za/contents/departments/res_policies/docs/ResearchEthicsPolicy_apprvCounc_21Sept07.pdf

Please note that the ethical clearance is granted for the duration of this project and if you subsequently do a follow-up study that requires the use of a different research instrument, you will have to submit an addendum to this application, explaining the purpose of the follow-up study and attach the new instrument along with a comprehensive information document and consent form.

Yours sincerely

Prof Ernest Mnkandla
Chair: College of Science, Engineering and Technology Ethics Sub-Committee

Prof IOG Moche
Executive Dean: College of Science, Engineering and Technology

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College of Science, Engineering and Technology
The Science Campus
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Florida Park, Roodepoort
Private Bag X6, Florida, 1710
www.unisa.ac.za/cset

UNISA college of science, engineering and technology

APPENDIX B: Communication for access to colleges

Supervisor: Prof JA van Biljon
Co-supervisor: Prof ME Herselman
College of Science, Engineering and Technology, School of Computing
University of South Africa (UNISA)
South Africa

30 July 2015

The Principal/ CEO
XXXXXXX College

Dear XXXXXXXX

Re.: Permission to apply the TVET-MIS-EVAL methodology at your college

We trust that you are well.

Mrs Mariette Visser, a doctoral student from UNISA whom we are supervising, is developing a methodology to evaluate management information systems (MIS) that public Technical and Vocational Education and Training (TVET) Colleges in South Africa are using to conduct their day-to-day business activities.

In the research study a methodology for the evaluation of management information systems will be developed based on the findings of previous studies and this method have to be tested on public TVET Colleges in South Africa which forms the application context of the study. The methodology of evaluation entails two main data gathering phases.

The first phase involves interview(s) which would not exceed one hour with the college's systems manager/(s) which could be the Principal/ CEO or data manager or information technology manager.

The second phase involves a paper based questionnaire which could take approximately 30 to 40 minutes to complete. It would be greatly appreciated if all staff who are using the management information system/(s) on a day-to-day basis could complete the questionnaire.

A one or two day visit to the college is envisaged and further follow-up calls for more information or clarification would be made via telephone or email communication if necessary.

Three public TVET Colleges in South Africa have been selected for participation in the study. The selection is based on a cluster random sampling strategy. Since the focus of the study is on the development of a methodology for evaluation, the identity of the institution and staff participants will be protected and kept as anonymous. All participants will furthermore be requested to sign an informed consent form (please refer to the attached consent form), which explains the confidentiality and anonymity of their and the institution's information.

Herewith we would kindly like to request your college's participation in the study and hope that this study will benefit your college and possibly other similar colleges in the future.

Your favourable consideration would be highly appreciated.

Kind regards

Prof JA van Biljon	Prof ME Herselman
Date:	Date:

(Enquiries: Tel: +27 11 670 9182, email: vbiljja@unisa.ac.za)

APPENDIX C: Consent form

UNISA college of science, engineering and technology

Research Information and Consent Form

Study title: A methodology for the evaluation of management information systems at public Technical and Vocational Education and Training Colleges in South Africa

Introduction
This is to get consent for your participation in a PhD research project conducted by Mariette Visser and supervised by Prof Judy van Biljon and Prof Marlien Herselman from the University of South Africa.

Purpose of research
This study is aimed at gathering your insights into the operation and use of the management information system(s) at your institution that you are using to conduct your day-to-day business activities towards developing a method for the evaluation of a management information system.

Procedure
The evaluation will require approximately 40 minutes of your time. We will ask you to complete a paper based questionnaire which will ask questions relating to your experiences with the college's management information system(s) that you are using to do your day-to-day business activities. We know that you cannot be absolutely certain about the answers to these questions but we ask that you try to think about these questions. When it comes to answering questions there are no right and wrong answers. We will be taking notes and possibly making an audio recording of the interaction but you will not be identified in any way.

Confidentiality.
The input you provide will be treated confidentially and only used towards the completion of the afore-mentioned research. All data will be used in summary form without reference to any individual or institution.

Participation
Participation in this research study is voluntary, and you have the right to, at any time, withdraw or refuse to participate.

Benefits and compensation
There aren't any direct benefits for your participation. All findings will be used for the completion of the academic qualification mentioned. No compensation will be provided to anyone partaking in this research.

Risks and discomforts
There are no risks or discomfort associated with your participation. All answers from you and other participants will be analysed collectively. Individual answers will therefore not be linked to any names, positions and institutions of participants.

Who to contact if you have been harmed or have any concerns
This research has been approved by UNISA Research Ethics Clearance Committee. If you have any complaints about ethical aspects of the research or feel that you have been harmed in any way by participating in this study, please contact Prof Ernest Mnkandla at mnkane@unisa.ac.za or Prof Ian Sanders at sandeid@unisa.ac.za.

If you have concerns or questions about the research you may call any one of the supervisors Prof JA van Biljon (011 670-9182 or vbiljja@unisa.ac.za) or Prof ME Herselman (012 841-3081 or mherselman@csir.co.za).

Participant consent

I have read and understood all the above. I willingly choose to participate in this study.
Full name (optional) ____
Date: ____
Signature: ____

APPENDIX D: Semi-structured interview schedule

A METHODOLOGY FOR THE EVALUATION OF MANAGEMENT INFORMATION SYSTEMS AT TECHNICAL AND VOCATIONAL EDUCATION AND TRAINING COLLEGES IN SOUTH AFRICA

INTERVIEW SCHEDULE

Theme 1: History and background of the MIS

1.1 Please describe the history of the MIS; when and how was it established and how did it develop? Is it one integrated system or separate components? Paper or electronic?

1.2 Please describe the user requirements as stated in the user requirement statement? (The user requirement(s) document (URD) or user requirement(s) specification is a document usually used in software engineering that specifies what the user expects the software to be able to do.)

1.3 Please describe the process, flow of activities from registration to graduation. Do you have a graphical representation of the flow of activities through the system? If you should draw a picture to illustrate your position regarding your responsibilities within the overall MIS, how would it look?

1.4 Is it possible to have a copy of the database design (tables, variables and relationships) of the MIS?

1.5 How heavily do the college's future plans rely on the information captured on the system? Which sources are being used for business management - planning for the future?

1.6 Tell me about the service provider of the system and also about training done on the system.

1.7 Please describe the importance of the college's website.

Theme 2: Business functions of the MIS

2.1 Please provide and describe the different components and functionalities of the system?

[Related Question: What can be done with the system? In which of the different components/functionalities do you have experience? Please tell me about your experiences?]

Theme 3: Information Quality

3.1 How would you describe the quality of the MIS in terms of the content and output reports? Information-Quality is concerned with the quality of the MIS outputs: namely, the quality of the information the system produces in reports and on-screen.

[Related Question: How would you describe the accuracy, currency, availability, usefulness of the data and information? Please describe the format and appearance of the output reports? Does it meet the needs of the FET College?]

Theme 4: Quality of the system

4.1 How would you describe the quality of the MIS in terms of the ease of use and the graphical user interface design?
(System-Quality of the MIS is a multifaceted construct designed to capture how the system performs from a technical and design perspective.)

[Related Question: Is it easy to use and learn the system? Is the design of the screens user friendly? Is the system easily accessible?]

Theme 5: Impact of the MIS on individuals

5.1 What is the effect of using the system on the lives of the individuals using the system?
(Individual-Impact is concerned with how the MIS has influenced your individual capabilities and effectiveness on behalf of the organization.)

[Related Question: Do you think that you have enhanced (are enhancing) your capabilities and technical skills, by using the system? Do you think that you are more effective and efficient in your work when using the system?]

Theme 6: Impact of the MIS on the organization

6.1 Please describe the impact of the MIS on the organization?
(Organizational-Impact refers to impacts of the MIS at the organizational level; namely improved organizational results and capabilities.)

[Related Question: Is the TVET College in a better position/competitive advantage by using this system? Do you think that the MIS is saving money? If yes, how does it save the TVET College on costs?]

Theme 7: Overall impression of the MIS

7.1 Please describe your overall satisfaction with the MIS?

[Related Question: Overall, are you satisfied with the MIS? Would you recommend the system to other TVET Colleges? If not, would you please provide suggestions for improvements?]

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8. Does your college use e-learning methods for teaching and learning (to convey the curriculum content to students)? How is it practically working?
9. Discuss the questionnaire with the contact person.
10. Is it possible to have a look at the system?

APPENDIX E: Survey questionnaire

A METHODOLOGY FOR THE EVALUATION OF MANAGEMENT INFORMATION SYSTEMS AT PUBLIC TECHNICAL AND VOCATIONAL EDUCATION AND TRAINING COLLEGES IN SOUTH AFRICA

USERS OF THE MANAGEMENT INFORMATION SYSTEM

2015

IDENTIFICATION

Unique ID:	OFFICIAL USE ONLY		
Respondent name:		**Home tel. no.:**	
Surname:		**Work tel. no.:**	
Email address:		**Cell phone no.:**	

Introduction

This questionnaire aims to evaluate different aspects of the Management Information System(s) (MIS) deployed at your institution. For instance, the questionnaire explores user satisfaction with components such as the quality and accuracy of the data and information, the support of the service provider, the overall functioning of the system and how individual employees and the organisation benefit from using the system.

Instructions

Please answer each question truthfully and to the best of your knowledge. For the majority of the questions you are required to select the most appropriate option with a cross mark (X).

Consent

The full consent form was circulated for your information. The information that you provide will be analysed and presented in a summarised format. All personal information will be anonymised. For formality:

1. Please understand that your participation is voluntary;
2. Your answers remain confidential; and
3. The questionnaire will take about 30-40 minutes to complete.

Signature of respondent: ______________________________

EMPLOYMENT INFORMATION

1. Please provide your position / post description? (e.g. Clerk, IT Manager, Administrator, Lecturer, etc.) [ ]

2. How would you categorise your position at the college?
   - Management staff 1
   - Lecturing staff 2
   - Support staff 3

3. Are you appointed Part-time or Full-time?
   - Part time 1
   - Full time 2

4. Are you a:
   - End-user 1
   - Key-user 2

5. Please provide the nature of your employment?
   - Contract / temporary (with fixed end date) 1
   - Permanent (no end date) 2
   - Casual (daily) 3

6. How many years of working experience do you have? [ ] (In full years)

7. How many years have you been working at this TVET College? [ ] (In full years)

8. How many years have you been using this MIS? (For work or other purposes.) [ ] (In full years)

9. Have you had training on the MIS system?
   - Yes 1
   - No 2

10. If you answered 'Yes' in question 9, was it in-house training by the TVET College or external training by the MIS service provider or both?
    - In-house 1
    - External 2
    - Both 3

11. How would you rate your competencies in:
(On a scale of 1 to 5, where 1 = poor and 5 = excellent.)

	Poor				Excellent
Technical skills [1]	1	2	3	4	5
Computer skills [1]	1	2	3	4	5
MS Word	1	2	3	4	5
MS Excel	1	2	3	4	5
Software for emailing	1	2	3	4	5

([1] Please refer to page 8 for definitions of the two terms.)

12. Please indicate with an 'X' which one of the statements below suits your Web/Internet proficiency the best: (Please select only one option.)
    - I have never used the Web 1
    - I have read pages on the Web 2
    - I have entered addresses (URLs) and/or used bookmarks 3
    - I can use a search engine to find information 4
    - I know my way around and have done Web transactions like e-banking, blog, online presence (twitter, facebook) 5

13. Please select the appropriate business processes for which you are/(have been) using the MIS system? For what purposes do/(did) you use the Management Information System (MIS)? (More than one option may be selected.)

<u>Student administration</u> 1

e.g. Student registration, Administration of students biographical and enrolment information, Student finance, Attendance, Student cards, Alumni, Time Tabling, etc.

<u>Academic administration</u> 2

e.g. Study programmes and qualifications, Examination enrolment, Examination administration, Academic records (assessments, examinations results etc.)

<u>Financial administration</u> 3

e.g. Budget management, Procurement, Expenditure records, Accounting package, etc.

<u>Human Resource management and development</u> 4

e.g. Appointments System, Leave System, Recruitment System, Evaluation System, Skills Development System, Disciplinary / Grievance System, Personnel iEnabler, Payroll management, Personnel records, Personnel utilization information, etc.

<u>Asset management</u> 5

e.g. Stock registers, Stock control, Physical infrastructure, Venue reservations, Vehicle reservations, etc.

<u>Technical Administration / Maintenance of the MIS</u> 6

e.g. Batch Processing, Printing, Contact Management, Enquiries, Web updates, etc.

MANAGEMENT INFORMATION SYSTEM EVALUATION

14. For each statement below, please select the rate that best describes your experiences with the Management Information System (MIS) that you are using at your organisation, where
    1 = Never or almost never;
    2 = some of the time;
    3 = about half of the time;
    4 = most of the time;
    5 = always or almost always and
    6 = not applicable / I don't know.

Category A: INDIVIDUAL-IMPACT is concerned with how the MIS has influenced your individual capabilities and effectiveness on behalf of the organization.

I have learnt much through the presence of the MIS	1	2	3	4	5	6
The MIS enhances my awareness of job related information	1	2	3	4	5	6
The MIS enhances my recall of job related information	1	2	3	4	5	6
The MIS enhances my effectiveness in the job	1	2	3	4	5	6
The MIS increases my productivity	1	2	3	4	5	6

Category B: INFORMATION-QUALITY is concerned with the quality of the MIS outputs: namely, the quality of the information the system produces in reports and on-screen.

Information available from the MIS is not important	1	2	3	4	5	6
The MIS contains all the key data that is needed	1	2	3	4	5	6
Information available from the MIS is always accurate (does not often need correction)	1	2	3	4	5	6
Information from the MIS is never updated and current	1	2	3	4	5	6
The MIS provides output that seems to be exactly what is needed	1	2	3	4	5	6
Information needed from the MIS is always available	1	2	3	4	5	6
Information from the MIS is in a format that is readily usable	1	2	3	4	5	6
Information from the MIS is not easy to understand	1	2	3	4	5	6
Information from the MIS appears readable, clear and well formatted	1	2	3	4	5	6
Information from the MIS is concise	1	2	3	4	5	6
Information from the MIS is always timely	1	2	3	4	5	6
Information from the MIS is unavailable elsewhere	1	2	3	4	5	6

Category C: SYSTEM-QUALITY of the MIS is a multifaceted construct designed to capture how the system performs from a technical and design perspective.

Statement						
The MIS is not easy to use	1	2	3	4	5	6
The MIS is easy to learn	1	2	3	4	5	6
It is not difficult to get access to information that is in the MIS	1	2	3	4	5	6
All data within the MIS is fully integrated and consistent	1	2	3	4	5	6
The MIS meets (the TVET College's) information requirements	1	2	3	4	5	6
The MIS does not include necessary features and functions	1	2	3	4	5	6
The MIS always does what it should	1	2	3	4	5	6
The MIS user interface (screen) can be easily adapted to one's personal approach (customize)	1	2	3	4	5	6
The MIS is always up-and-running as necessary (It has good connectivity, e.g. to network, server access, etc.)	1	2	3	4	5	6
The MIS programme speed is quickly enough (responds quickly)	1	2	3	4	5	6
The MIS requires only the minimum number of fields and screens to achieve a task	1	2	3	4	5	6
Modifications to the functionality of the MIS can easily be done (modified, corrected and improved)	1	2	3	4	5	6
The MIS's service provider[2] is reliable	1	2	3	4	5	6
The MIS's service provider[2] has up-to-date facilities	1	2	3	4	5	6
The MIS's service provider[2] is experienced	1	2	3	4	5	6
The MIS's service provider[2] provides quality training	1	2	3	4	5	6
The MIS's service provider[2] provides quality services	1	2	3	4	5	6

([2] For End-users the term 'service provider' refers to the college's ITS unit, for key-users it refers to the external MIS service provider.)

Category D: ORGANIZATIONAL-IMPACT refers to impacts of the MIS at the organizational level; namely improved organizational results and capabilities.

Statement						
The MIS has resulted in overall productivity improvement	1	2	3	4	5	6
The MIS has resulted in improved outcomes or outputs	1	2	3	4	5	6
The MIS has resulted in an increased capacity to manage a growing volume of activity (e.g. transactions, population growth, etc.)	1	2	3	4	5	6
The MIS has resulted in improved business processes	1	2	3	4	5	6
The MIS has helped to improve communication and relationships with partners such as DHET, SETAs, government, private companies, etc.	1	2	3	4	5	6
The MIS is cost effective	1	2	3	4	5	6
The MIS has resulted in reduced staff costs	1	2	3	4	5	6
The MIS has resulted in cost reductions (e.g. inventory holding costs, administration expenses, etc.)	1	2	3	4	5	6

Category E: USER SATISFACTION - About your satisfaction with the MIS

Here we would like to learn your opinion about the MIS with regard to the following categories.

Content						
How often does the system provide the precise information you need?	1	2	3	4	5	6
How often does the system provide reports that seem to be just about exactly what you need?	1	2	3	4	5	6
How often does the information content meet your needs?	1	2	3	4	5	6
Accuracy						
How often is the system accurate?	1	2	3	4	5	6
How often are you satisfied with the accuracy of the system?	1	2	3	4	5	6
How often have you detected inconsistencies and inaccuracies in the content of the output reports from the system?	1	2	3	4	5	6
Format						
How often do you think the output is presented in a useful format?	1	2	3	4	5	6
How often is the information clear?	1	2	3	4	5	6
Ease of use						
How often is the system user-friendly?	1	2	3	4	5	6
How often is the system easy to use?	1	2	3	4	5	6
Timeliness						
How often do you get the information you need in time?	1	2	3	4	5	6
How often does the system provide up-to-date information?	1	2	3	4	5	6

Category F: Overall assessment of the MIS.

1. Overall, how satisfied are you with the MIS in your working environment?	1	2	3	4	5	6
2. Overall, how satisfied are you with using the MIS?	1	2	3	4	5	6
3. Overall, how satisfied are you with the quality of the data captured within the MIS?	1	2	3	4	5	6
4. Overall, how satisfied are you with the quality of the outputs from the MIS?	1	2	3	4	5	6
5. How often are you prevented from or delayed in using the system due to computer errors, system crashes or other machine related problems?	1	2	3	4	5	6
6. How often are you prevented from or delayed in using the system due to password problems?	1	2	3	4	5	6
7. How often are you prevented from or delayed in using the system because the system is working too slowly?	1	2	3	4	5	6

8. All considered to what extent has the MIS changed the following two aspects of <u>your own</u> unit or department?

	Significantly more difficult	*More difficult*	*Slightly more difficult*	*No change*	*Slightly easier*	*Easier*	*Significantly easier*
a. The performance of our unit's/department's work has become:	☐	☐	☐	☐	☐	☐	☐

	Significantly decreased	*Decreased*	*Slightly decreased*	*No change*	*Slightly increased*	*Increased*	*Significantly increased*
b. The quality of our unit's/department's work has become:	☐	☐	☐	☐	☐	☐	☐

9. How much do you agree with the following statement?

	Strongly disagree	*Disagree*	*Slightly disagree*	*Neutral*	*Slightly agree*	*Agree*	*Strongly agree*
The MIS is worth the time and effort to use it:	☐	☐	☐	☐	☐	☐	☐

10. All considered how would you rate your satisfaction with the MIS in your unit/department?

Non-existent	*Poor*	*Fair*	*Good*	*Excellent*
☐	☐	☐	☐	☐

11. All considered how would you rate the success of the MIS in your unit/department?

Non-existent	*Poor*	*Fair*	*Good*	*Excellent*
☐	☐	☐	☐	☐

Category G: Comments

In your opinion, are any of the functions in the MIS particularly useful? If so, please explain.

In your opinion, are any of the functions in the MIS not very useful? If so, please explain.

Do you miss any functionality in the MIS? If so, please explain.

Were parts of the questionnaire unclear or ambiguous? If so, please explain. We would also welcome other comments.

PERSONAL INFORMATION

Please tick the appropriate boxes where applicable?

1. Population group:

African	1
Coloured	2
Indian	3
White	4
Other	5

2. Gender:

Male	1
Female	2

3. Date of birth : yyyy/mm/dd

4. Are you a person living with a disability?

None	1
Sight (blind / severe visual limitation)	2
Hearing (deaf, profoundly hard of hearing)	3
Communication (speech impairment)	4
Physical (e.g. needs wheelchair, crutches or prosthesis)	5
Intellectual (serious difficulties in learning)	6
Emotional (behavioural, psychological)	7

5. Please provide your highest academic qualification?

Not applicable	1
Std 1 / Gr 3 (NQF 0 (ABET 1))	2
Std 3 / Gr 5 (NQF 0 (ABET 2))	3
Std 5 / Gr 7 (NQF 0 (ABET 3))	4
Std 7 / Gr 9 (NQF 1 (ABET 4))	5
N1 (NQF 2)	6
Std 8 / Gr 10 (NQF 2)	7
N2 (NQF 3)	8
Std 9 / Gr 11 (NQF 3)	9
Matric (NQF 4)	10
N3 (NQF 4)	11
Higher certificate (NQF 5)	12
Diploma / Advanced certificate (NQF 6)	13
Bachelor's degree / Advanced diploma (NQF 7)	14
Honours degree / Post graduate diploma (NQF 8)	15
Master's degree (NQF 9)	16
Doctorates (NQF 10)	17

6. Which ONE of the following languages do you speak the most at home?

Afrikaans	1
English	2
IsiNdebele	3
Sepedi	4
Sesotho	5
Seswati	6
Setswana	7
Tshivenda	8
IsiXhosa	9
IsiZulu	10
Xitsonga	11
Other	12

THANK YOU FOR YOUR CO-OPERATION

Definitions:

Computer skills: Level of familiarity with the basic hardware and software (and now Internet) concepts that allows one to use personal computers for data entry, word processing, spreadsheets, and electronic communications.

Technical skills: Knowledge and proficiencies required in the accomplishment of engineering, scientific, or any specific task. The knowledge and abilities needed to accomplish mathematical, engineering, scientific or computer-related duties, as well as other specific tasks. Those with technical skills are often referred to as "technicians" in their chosen field, i.e. audio technicians, electronics technicians, engineering technicians, etc. Microsoft Corporation even offers accreditation as a Microsoft Certified Desktop Support Technician (MCDST).

APPENDIX F: Clusters of public TVET Colleges - Outcome of the innovative evidence-based clustering method

College * TwoStep Cluster Number Crosstabulation				
TVET College	Cluster 1	Cluster 2	Cluster 3	Total
Boland FET College	0	0	1	1
Buffalo City FET College	0	1	0	1
Capricorn FET College	0	1	0	1
Central JHB FET College	0	1	0	1
Coastal FET College	0	1	0	1
College of Cape Town FET College	0	1	0	1
East Cape Midlands FET College	0	1	0	1
Ehlanzeni FET College	0	0	1	1
Ekurhuleni East FET College	0	0	1	1
Ekurhuleni West College	0	1	0	1
Elangeni FET College	1	0	0	1
Esayidi FET College	0	1	0	1
False Bay FET College	0	0	1	1
Flavius Mareka FET College	0	0	1	1
Gert Sibande FET College	0	1	0	1
Goldfields FET College	0	0	1	1
Ikhala FET College	0	0	1	1
Ingwe FET College	0	0	1	1
King Hintsa FET College	0	0	1	1
King Sabata Dalindyebo FET College	0	0	1	1
Lephalale FET College	0	1	0	1
Letaba FET College	0	0	1	1
Lovedale FET College	0	1	0	1
Majuba FET College	0	1	0	1
Maluti FET College	0	1	0	1
Mnambithi FET College	0	1	0	1
Mopani South East FET College	0	1	0	1
Motheo FET College	0	1	0	1

College * TwoStep Cluster Number Crosstabulation				
TVET College	Cluster 1	Cluster 2	Cluster 3	Total
Mthashana FET College	0	1	0	1
Nkangala FET College	0	0	1	1
Northern Cape Rural FET College	0	0	1	1
Northern Cape Urban FET College	0	1	0	1
Northlink FET College	0	0	1	1
Orbit FET College	0	1	0	1
Port Elizabeth FET College	0	0	1	1
Sedibeng FET College	0	1	0	1
Sekhukhune FET College	0	1	0	1
South Cape FET College	0	1	0	1
South West FET College	0	0	1	1
Taletso FET College	1	0	0	1
Thekwini FET College	0	1	0	1
Tshwane North FET College	0	1	0	1
Tshwane South FET College	0	1	0	1
Umfolozi FET College	0	0	1	1
Umgungundlovu FET College	0	1	0	1
Vhembe FET College	1	0	0	1
Vuselela FET College	0	1	0	1
Waterberg FET College	0	1	0	1
West Coast FET College	0	1	0	1
Western College FET College	0	1	0	1
Total	3	30	17	50

APPENDIX G: Summary of the innovative evidence-based clustering method

Steps in the innovative evidence-based clustering method:

Step 1: Decide which characteristics the clusters should be included, based on the research study for which the cases are required.

Step 2: Do a literature study on the characteristics under investigation (in this study, the IS characteristics of public TVET Colleges, based on the web maturity level of the websites).

Step 3: Design and develop (based on extant literature) a survey or evaluation questionnaire to capture appropriate quantitative data on the characteristics.

Step 4: Select and brief reviewers or data collectors.

Step 5: Collect the data and compile into an electronic data set.

Step 6: Import the data set into a statistical software package and perform descriptive and inferential statistical procedures to ensure a rigorous outcome.

Step 7: To calculate the ICC, the following steps were followed separately for variables *evalq4*[i] and *evalq5*[i]: in IBM SPSS, select ‘Analyse’, ‘Scale’, ‘Reliability Analysis’, then select the appropriate variables (in this study, first *evalq4*[i] and then *evalq5*[i] in the second analysis), then click on ‘Statistics’. Make sure that the box next to ‘Intraclass Correlation Coefficient’ is checked. After the ICC box has been checked, select the ‘Two-way Random’ (or context applicable) model and the ‘Absolute Agreement’ type. Then run the analyses.

Step 8: Three variables were created for inclusion in a cluster analysis (*Avgq4*, *Avgq5*, *Compfinal*). The following steps were followed in IBM SPSS: select ‘Analyse’, ‘Classify’, ‘TwoStep Cluster’. Then select the variables and place them in the applicable variable type box (categorical/ continuous). Change the ‘Determine automatically maximum’ clusters to the required number (in this study, 4 was chosen). Under ‘Output’, check ‘Create cluster membership variable’, to enable the creation of a variable for the classification of the TVET Colleges.

Step 9: Select cases from each cluster, as appropriate.

APPENDIX H: Website evaluation questionnaire

EVALUATION OF TVET COLLEGES' WEBSITES

Page1 | Page2 | Page3

UniqueID:

Province:

College:

URL:

q1: Does the college have a website?

q2: When (year) was the website established?

q3: Has the website been updated in 2015?

Please provide a score for each of the following questions from 1 to 5, where 1=Poor and 5=Excellent.

4a)	Rate your first impression about the **STRUCTURE** (identifiable components which give form to the website) of the website?
4b)	Rate your first impression about the **APPEARANCE / GRAPHICS** (look and feel) of the website?
4c)	Rate to what extent does the website **CATER** for its main clients which are the **STUDENTS?**
4d)	How easy is it to **NAVIGATE** around on the website?
4e)	**HOW EASY** is it to find information on **HOW TO REGISTER** at the college?
4f)	**HOW EASY** is it to find information on the **PROGRAMMES** offered at the college?
4g)	Rate to what extend the **LINKS** on the website work? (1=found more than one link not working; 2=found one link not working; 3=website doesn't have many links but found no links not working; 5=complex website and all links selected worked well.)

q4:How would you rate the overall appearance of the text and graphics of the website in terms of appearance, clarity, ease of use and accessibility? Please use a scale from 1 to 5 where 1=Poor and 5=Excellent.

Go to page 2

EVALUATION OF TVET COLLEGES' WEBSITES

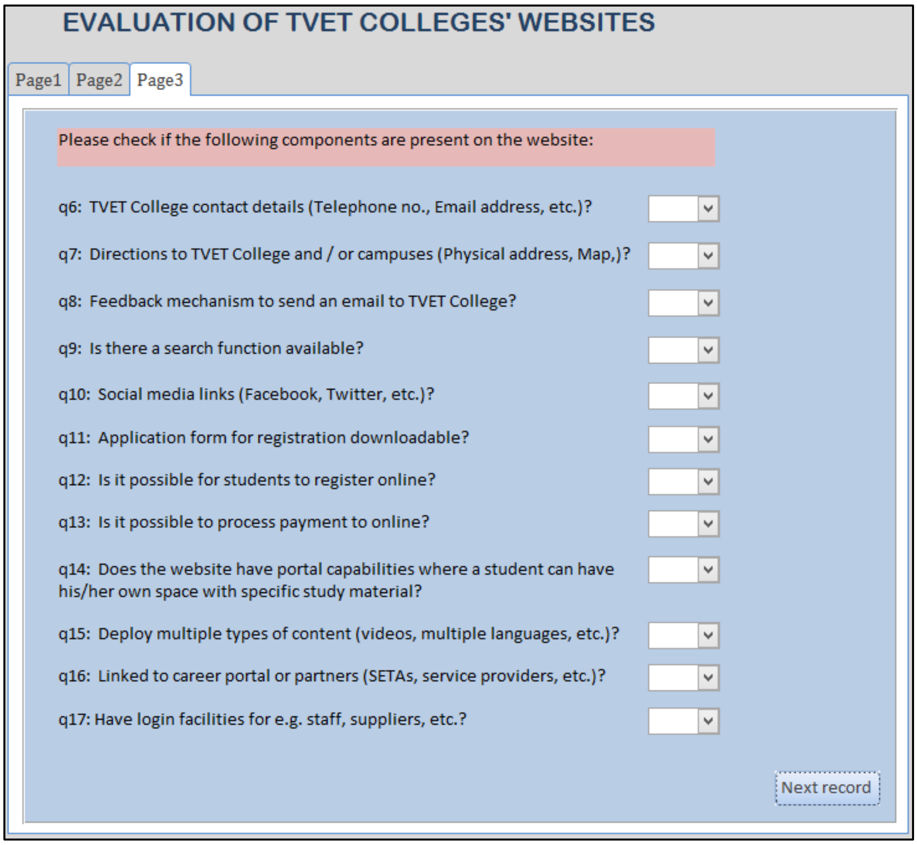
Page1 | Page2 | Page3

Please provide a score for each of the following questions from 1 to 5, where 1=Poor and 5=Excellent.

5a)	To what extent does the website provide information about **STUDENT LIFE** (in terms of entertainment, sport or cultural activities) on the campus?
5b)	To what extent does the website provide information about the procedure to apply for **REGISTRATION**?
5c)	To what extent does the website provide information about the **PROGRAMMES and COURSES** offered at the college?
5d)	To what extent does the website provide information on available **TENDERS for SUPPLIERS** or service providers?
5e)	To what extent does the website provide information on **VACANCIES** (for prospective staff) at the college?

q5: How would you rate the general information and information on programmes, courses and procedures on how to apply and register of the website in terms of completeness? Please use a scale from 1 to 5 where 1=Poor and 5=Excellent.

Go to page 3



EVALUATION OF TVET COLLEGES' WEBSITES

Page1 Page2 Page3

Please check if the following components are present on the website:

q6: TVET College contact details (Telephone no., Email address, etc.)?

q7: Directions to TVET College and / or campuses (Physical address, Map,)?

q8: Feedback mechanism to send an email to TVET College?

q9: Is there a search function available?

q10: Social media links (Facebook, Twitter, etc.)?

q11: Application form for registration downloadable?

q12: Is it possible for students to register online?

q13: Is it possible to process payment to online?

q14: Does the website have portal capabilities where a student can have his/her own space with specific study material?

q15: Deploy multiple types of content (videos, multiple languages, etc.)?

q16: Linked to career portal or partners (SETAs, service providers, etc.)?

q17: Have login facilities for e.g. staff, suppliers, etc.?

Next record

APPENDIX I: Proof of proofreading of the thesis

EsteeWiese

Proofreading of academic texts

BA HDE
estee.wiese@gmail.com
Mobile: +27 (0)83 6070376

Certificate of Editing

To whom it may concern

This is to certify that the manuscript detailed below was edited by a English language academic editor.

Estee Wiese
estee.wiese@gmail.com

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Manuscript Author:	*Margaretha Maria Visser*
Institution:	*University of South Africa* *Student number: 34747788*

Esteé Wiese BA HED
estee.wiese@gmail.com
Skype: estee.wiese